FINNISH NATIONAL DEFENSE UNIVERSITY

COGNITIVE BIASES WITHIN INTELLIGENCE ANALYSIS - A CASE STUDY WITHIN SELECTED TEAMS IN THE TACTICAL LEVEL OF THE LAND COMPONENT

Thesis

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ABSTRACT

Intelligence analysis is a process, where bits and pieces of information are formed into products that allow the commander to understand events occurring and to evaluate likely future courses of action. This process is affected by the cognitive traits of the analysts, leading to cognitive biases possibly having a negative impact on the products. The aim of this research was to study how selected cognitive biases appear within intelligence analysis within the tactical level of the land component in two selected cases. Five cognitive biases were chosen for this research. The selection was based on previous research published within the field of intelligence analysis.

The framework of the research was meta-analyzed from literature found from research databases. The empirical part of the research used triangulation (data and method) to gather the maximum amount of data from two exercises hosted by a computer-aided simulator. Supportive questionnaires were used to examine the background of the analysts. Passive observation was used as the primary method during the exercises, with questionnaires, interviews and comparison of products to simulator data used as supportive methods. Use of previous research methodology in other fields was used as a starting point for this research; the methods were combined and tailored to be suitable for the setup of this particular research.

Of the selected biases, confirmation bias was observed very frequently in both cases. Group thinking bias was observed very frequently in the second case of this research. Both biases were found to affect the analysis process. Especially the effect of group thinking bias was found to be hard to evaluate by the analysts themselves, even after the exercise being studied. The other selected biases (mirror imaging, vividness bias, anchoring effect) were all observed, but less frequently. The use of structured analysis techniques were found to have very little impact on the frequency of the biases or their effects - the use of the techniques was however observed to be at a very elementary level by the analysts in the relevant cases.

The results of the research lead to two recommendations: simple structured analytical techniques should be focused on more during the early phases of the analysts training to lessen the impact of cognitive biases, and that the composition of the analyst teams should be heterogeneous to avoid group thinking bias.

KEY WORDS

Intelligence, Intelligence analysis, Cognitive psychology, Cognitive bias, Confirmation bias, Group thinking bias, Warfare, Operational arts and tactics, Structured analysis techniques

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1 INTRODUCTION

The greatest derangement of the mind is to believe in something because one wishes it to be so. -Louis Pasteur[1]

The most crucial part of succeeding on the battlefield is situational awareness across the spectrum. Anticipating what the opponent is planning prior to execution is essential. For this purpose, every commander has a section of their headquarters dedicated to gathering and analyzing intelligence concerning the opponent's actions. Understanding how the commander's requirements for information are fulfilled by first gathering information and then analyzing it into products that answer the commander's intelligence needs is a vital part of bettering the process.[2]

Richards J. Heuer describes analyzing information as a skill "*similar to carpentry or driving a vehicle. It can be taught, learned, and it can improve with practice. But like many other skills, it is not learned by sitting in a classroom and being told how to do it. Analysts learn by doing.*"[3] The human factor is always present within the dissemination of data into analyzed estimates. This factor causes flaws in the process of taking bits and pieces of collected information and processing it into products such as estimates of the opponent's intents. What people perceive, how readily they perceive it, and how they process this information after receiving it are all strongly influenced by past experience, education, cultural

[1] Dubos, René J.: *Louis Pasteur, Free Lance of Science*, Little, Brown and Company, Boston, 1950, 376
[2] Field Manual No. 2-0: Intelligence, Headquarters, Depart of the Army, Washington, DC, 2004.1-1 - 1-2.
[3] Heuer Jr., Richards J.: *Psychology of Intelligence Analysis*, Center for the Study of Intelligence, Central Intelligence Agency, 1999, 2

values, role requirements, and organizational norms, as well as by the specifics of the information received.[4]

Intelligence, and especially drastic failures within it, has been examined by a broad scale of actors especially after the public intelligence failures concerning the events of 9/11 in 2001 and the Iraq weapons of mass destruction programs in 2003. This has led to the shift of intelligence from a closed and secretive form of art to a science. The public starting point of this shift can be argued to be the report of the Select Committee on Intelligence (US Senate), which went through the analysis process of the US intelligence community leading to the mentioned failures. The recommendations and conclusions of this committee are still valid in understanding how cognitive biases lead to failures particularly in analytic trade craft.[5]

The general mental ability and subject-matter expertise of intelligence analysts has been studied rigorously after the recommendations made by the Select Committee on Intelligence. The analysts of the US military have been shown to require a broad scale of cognitive competencies.[6] These requirements for analysts are universal. They however cause the analysts to be susceptible to cognitive biases, with the biases *creeping into finished products*.[7] The effect is enhanced with typical constraints caused by the nature of intelligence, especially time constraints and secrecy.[8] Surprisingly little attention has been focused on the training of analysts, granting them the cognitive skills and tools needed for intelligence analysis.[9]

Cognitive biases can be used by the opposing force, when employing deception against the analysts and decision makers. Historically decision makers have been the weakest link in the OODA chain[10], thus understanding their cognitive biases can make them vulnerable to

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[4] Heuer (1999), p. 4

[5] Report of the Select Committee on Intelligence on the U.S. Intelligence Community's Prewar Intelligence Assessments on Iraq together with Additional Views, 2004 [https://www.intelligence.senate.gov/sites/default/files/publications/108301.pdf] (26.7.2018)

[6] Lytell, Maria C., Susan G. Straus, Chad C. Serena, Geoffrey Grimm, James L. Doty III, Jennie W. Wenger, Andrea A. Golay, Andrew M. Naber, Clifford A. Grammich, Eric S. Fowler: *Assessing Competencies and Proficiency of Army Intelligence Analysts Across the Career Life Cycle*, Santa Monica, CA, RAND Corporation, 2017 [https://www.rand.org/pubs/research_reports/RR1851.html], pp. 9-14

[7] Johnston, Rob: *Analytic Culture in the US Intelligence Community: An Ethnographic Study*, Washington, D.C., The Center for the Study of Intelligence, 2005, p. 10

[8] Ibid, pp. 10-29

[9] Chang, Welton & Philip E. Tetlock: *Rethinking the training of intelligence analysts* in Intelligence and National Security, 2016

[10] The OODA chain (Observation, Orientation, Decision, Action) was originally developed by US Air Force Colonel John Boyd. As Boyd only presented his concept in a briefing (The Essence of Winning and Losing (1995)), a secondary source is used: MacCuish, Donald A.: *Orientation: Key to the OODA Loop - The Culture Factor*, Journal of Defense Resources Management, Vol 3, Iss 2, pp 67-75, 2012, pp. 67-68

deception. These cognitive biases can then be used to make deception work - if they are not taken into consideration, then deception has a lower probability of working as intended.[11]

2 CURRENT SITUATION OF RESEARCH AND METHODS

This chapter gives an overview of the current situation of research and source material of the thesis. The status and material is briefly presented within the chapter (subchapters 2.1. and 2.5.) and evaluated in appendix one. The scope, aim and limitations are presented and justified in subchapter 2.2.

Research methods and the structure of the study are presented in subchapter 2.3. This subchapter describes how data was collected within the field studies. Research ethics are examined and discussed in subchapter 2.4.

The aim of this chapter is to give the reader an understanding on the broader situation of research within the field of the thesis, with a focus on the Finnish Defense Forces (FDF). The chapter answers the question "*how was the research conducted?*"

2.1 Current situation of research

Cognitive psychology has been extensively researched after World War II. Essentially, a generation came back from the war and changed the view of psychology from behaviorism to cognitive psychology.[12] However, there has been no thesis within the Finnish National Defense University (FNDU) focusing solely on cognitive psychology. The topic has been skirted with theses concerning intelligence analysis. This subchapter will present these theses and two other relevant doctoral dissertations.

Intelligence analysis has been recently studied within the FNDU in a few theses. In general, the classification of these theses is at least restricted or confidential, which limits the use of these theses in this research. Unclassified (thus available) international research on the topic is mostly available from the intelligence community in the USA in the form of published

[11] Clark, Robert M. & William L. Mitchell: *Deception: counterdeception and counterintelligence,* CQ press, SAGE Publications, Inc., California, 2018, pp. 162-168
[12] Anderson, John R.: *Cognitive Psychology and Its Implication,*. 8th ed, New York, Worth Publishers, 2015, p. xvii

books and articles. Other international research concerning especially military intelligence is probably classified and thus publicly unavailable, which limits use in this research.[13]

Lisa-Christina Winter's doctoral dissertation "*Mitigation and Prediction of the Confirmation Bias in Intelligence Analysis"* focuses on mitigating confirmation bias within intelligence analysis. The research was initiated during the "RECOBIA" (Reduction of Cognitive Biases in Intelligence Analysis) project[14], which had the ultimate goal of improving intelligence analysis by reducing the negative impact of cognitive biases in intelligence analysis. The dissertation is rare in the manner of conducting independent empirical research within intelligence analysis, and being public. The research method however differs from this thesis.[15] The dissertation was published in December 2017; the researcher was made aware of the dissertation in September 2018, when the empirical data of this thesis was already collected. This reduced the use of this dissertation within the initial work of this thesis, but it was used when finalizing the thesis as a supportive source of data.[16]

Martin Bang's doctoral dissertation "*Military Intelligence Analysis: Institutional Influence"* seeks to better understand military intelligence analysis. His overarching research question is "*How do military intelligence institutions influence intelligence analysis?*" The dissertation is structured in two parts: the introductory section and five articles. While the dissertation focuses on institutional influence and the strategic level of the intelligence process, it has numerous connecting points with this thesis, as cognitive biases are studied within the context of military intelligence analysis.[17]

Kai Känä's thesis for general staff officer course (GSOC) 58 "*Diskurssianalyysi tiedusteluanalyysin lähestymistapana - Venäjän Syyrian operation diskurssiivinen tarkastelu" (Dis-*

[13] When searching for papers dealing with "military intelligence analysis", google scholar returns 412 results (compared with "intelligence analysis", which returns 33 800 results). These results are associated with the books/articles used in this thesis. Heuer is cited on almost all the results, providing reason to use his views as a starting point for this thesis. The results connected with "intelligence analysis" are on a broader spectrum, interconnected with cognitive psychology and decision making.

[14] RECOBIA project website (www.recobia.eu (26.9.2018)). The project was conducted from FEB 2012 to JAN 2015.

[15] Winter conducts a case research, in which she has so called laboratory cases which she presents to analysts, with control groups being used for comparison. This research relies on using an environment already present to gather empirical data.

[16] Winter, Lisa-Christina: *Mitigation and Prediction of the Confirmation Bias in Intelligence Analysis*, Karl-Franzens-Universität, Graz, 2018 [https://www.researchgate.net/publication/321309639_Mitigation_and_Prediction_of_the_Confirmation_Bias_in_Intelligence_Analysis] (26.9.2018). The dissertation was published on researchgate.net on the 7th SEP 2018.

[17] Bang, Martin: *Military Intelligence Analysis: Institutional Influence,* National Defense University, Series 1: Research Publications No. 14, Juvenes Print, Tampere, 2017

course analysis as a method of intelligence analysis - a discursive examination of Russia's operation in Syria) studies the use of discourse analysis as a method of intelligence analysis. He examines debiasing when using discourse analysis extensively in the main section of his thesis, which links it to this thesis.[18]

Annukka Ylivaara's thesis for GSOC 58 "*Tulevaisuden arviointi strategisessa tiedustelussa*" (*Future Estimates within Strategic Intelligence)* studies future estimations within the context of strategic intelligence. Within the thesis, she studies the role of different tasks given to strategic intelligence (current, forewarning, analyzing, preparing, and supporting long-term planning) and compares these to prior empirical research and recommendations. Within her own empirical part (restricted), she studies how the recommendations appear within Finnish strategic intelligence reports. While this part of her research has some connections to this thesis (concerning intelligence within the context of the Finnish Defense Forces (FDF)), the restriction limits its use. Her focus being on the strategic level also limits the use within this thesis.[19]

Perttu Trontti's thesis for GSOC 58 "*Strategisen tason tiedustelun tietotarpeiden täyttäminen pienessä valtiossa (ST IV)"* (*Fulfilling Requirements of Information of Strategic Intelligence within a Small Nation (restricted))* studies the strategic intelligence process with the point of view of a small nation. While the thesis focuses on the FDF (and other strategic intelligence actors in Finland) and the intelligence process, the classification (restricted) and level decrease the usability within this thesis. The most useful conclusion of Trontti's thesis is that the problems with the intelligence process presented in recent theoretical models are valid within the context of a small nation.[20]

Tero Hannonen's thesis for GSOC 58 "*Harhauttaminen vaikuttamiskeinona nykyaikaisessa sodankäynnissä (ST IV)" (Deception as a Capability in Modern Warfare (restricted))* stud-

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[18] Känä, Kai: *Diskurssianalyysi tiedusteluanalyysin lähestymistapana - Venäjän Syyrian operation diskurssiivinen tarkastelu [Discourse analysis as a method of intelligence analysis - a discursive examination of Russia's operation in Syria] (*translated by author), GSOC 58 thesis, NDU, Helsinki, 2017. See especially pp. 100-107.

[19] Ylivaara, Annukka: *Tulevaisuuden arviointi strategisessa tiedustelussa" [Future Estimates within Strategic Intelligence]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017. Part of the thesis is restricted (37 pages of the actual theses and appendix 1). Readers with access to this material can view the restricted appendix to gain a view of strategic intelligence analysis within the context of the FDF.

[20] Trontti, Perttu: *Strategisen tason tiedustelun tietotarpeiden täyttäminen pienessä valtiossa (ST IV) [Fulfilling Requirements of Information of Strategic Intelligence within a Small Nation (restricted)]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017. Readers with access to this material can view especially chapter four, which examines the intelligence process and presents alternatives to the traditional intelligence cycle.

ies deception and diversion within the frame of modern warfare, using source material concerning non-kinetic capabilities and cognitive psychology. His thesis established that for deception to work, it needs to be based on prejudice. For maximum effect, the opponent's intelligence process (emphasizing the analysis process) must be known, so the cognitive biases can be fed. The thesis focuses on the opposite view of this thesis (trying to find how to use cognitive biases, while the aim of this thesis is to debias the effects), which makes it an interesting source.[21]

Lasse Ahonen's thesis for GSOC 58 "*Tiedusteluprosessi alueellisessa johtoportaassa (ST III)" (The Intelligence Process within Regional Headquarters (confidential))* studies the intelligence process at the FDF army tactical level. While relevant to this thesis due to the exceptionally detailed research concerning the process within the same environment as this thesis, the classification class of "*CONFIDENTIAL"* prevents use within the unclassified parts of this thesis. The author has however familiarized oneself with the thesis, and parts are used in the restricted appendixes of this thesis.[22]

Ulla Murtomäki's thesis for GSOC 56 "*Strukturoitujen analyysimenetelmien käytettävyys uhka-arvioiden laadinnassa" (The Usability of Structured Analysis Methods in Threat Assessments (restricted))* focuses on structured analysis methods. Her thesis focuses on the analysts and the methods they use when making threat assessments. Her most important sources of methods are from Richards J. Heuer Jr.'s and Randolph H. Pherson's "*Structured Analytic Techniques for Intelligence",* and non-classified analysis and training material used in the United States of America, Great Britain and NATO.[23]

Jaakko Jäntti's thesis for staff officer course (SOC) 62 "*Tiedusteluanalyysi: analyysikoulutuksen vaikuttavuuden merkitys" (Intelligence Analysis: the Impact on Analysis Training (restricted))* focuses on intelligence analysis and especially improving training given within

[21] Hannonen, Tero: *Harhauttaminen vaikuttamiskeinona nykyaikaisesa sodankäynnissä (ST IV) [Deception as a Capability in Modern Warfare (restricted)]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017
[22] Ahonen, Lasse: *Tiedusteluprosessi alueellisessa johtoportaassa (ST III) [The Intelligence Process within Regional Headquarters (confidential)]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017
[23] Murtomäki, Ulla: *Strukturoitujen analyysimenetelmien käytettävyys uhka-arvioiden laadinnassa (ST IV) [The Usability of Structured Analysis Methods in Threat Assessments (restricted)]* (translated by author), GSOC 55 thesis, NDU, Helsinki, 2013. Her thesis is classified as "Restricted", which reduces the use of the thesis within this research. Readers with access can see pp. 19-20 for sources and pp. 21-21 on her view of intelligence analysis as a process.

the field of analysis. His thesis uses Heuer's list of probable cognitive biases, which supports the choice to focus on Heuer's choices on relevant biases.[24]

As a summary, intelligence analysis has been studied within the context of this thesis in the near past. The field of cognitive psychology and cognitive biases has however not been focused on within the context of intelligence analysis (within the frame of the FDF), which justifies the subject of this study.

2.2 Scope, aim and limitations

The field of intelligence analysis has been a focus point of research especially during the past twenty five years.[25] Intelligence analysis however is argued to lack theories. There is also a lack in empirical studies concerning intelligence analysis.[26] Thus academic research of intelligence analysis and affecting cognitive biases within the framework of the Finnish Defense Forces (FDF) can be seen as purposeful, especially as the field has not been studied before within this context.

The aim of the research is to gain an understanding of the effects of cognitive biases within intelligence analysis conducted at the tactical level of the Finnish Army.[27] For this aim, the scope of the research should embrace a range of approaches and schools of thought. Consequently, this raises a need to describe the framework in which the analysis process occurs. The research seeks practical applicable suggestions in improving analysis. Combined, these aims can be formulated into the following research question:

1. *How do selected cognitive biases appear within intelligence analysis within the tactical level of the land component in two selected cases?*

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[24] Jäntti, Jaakko: *Tiedusteluanalyysi: analyysikoulutuksen vaikuttavuuden merkitys (ST IV) [Intelligence Analysis: the Impact on Analysis Training (restricted)] (translated by author),* SOC 62 thesis, NDU, Helsinki, 2010. The thesis is classified as "Restricted", which reduced the use of the thesis within this research. Readers with access can see pp. 16-21 on views of cognitive biases, and chapter 4 on analysis techniques.

[25] Bang (2017), p. 8

[26] Bang (2017), p. 9

[27] This thesis uses the definition of "*tactical level"* as defined by the FDF Field Manual [Kenttäohjesääntö yleinen (ST IV), Juvenes print, Tampere, 2015] p. 24: *At the tactical level service branches lead their subordinate units' battle, joint efforts and the define needs for FDF common assets (*translated by author). Field Manual 3.1 Army operations [Kenttäohjesääntö 3.1 Maaoperaatiot (ST IV), Juvenes print, Tampere, 2016] p. 15, defines "*tactical level"* as operations (including battles) conducted by an army group [armeijakunta], military area [sotilasalue] or brigade [prikaati] and battles conducted by a battle group (taisteluosasto) or battalion (pataljoona) (translated by author). The difference between definitions does not affect this thesis, as both definitions include the level being studied, which is above the level of *battle technique* (taistelutekniikka), which refers to actions conducted by the company level organization and below.

To reach the aim of negating the effect of cognitive biases within the analysis process, the following sub questions are formed:

1. *What cognitive biases are most probably present within two selected cases?*
2. *How do the professional backgrounds of analysists affect the impact of cognitive biases?*
3. *How do cognitive biases affect the intelligence analysis in two selected cases?*
4. *How do selected structured analyzing techniques affect the impact of cognitive biases in two selected cases?*

The research is limited to examining the FDF land component tactical level, due to availability of suitable field exercises within the Finnish National Defense University. Using abduction, the results will be generalized to a wider field concerning the process of analysis. Concerning information security, the aim was to keep the research unclassified. Needed appendixes were classified and not included in the public report.

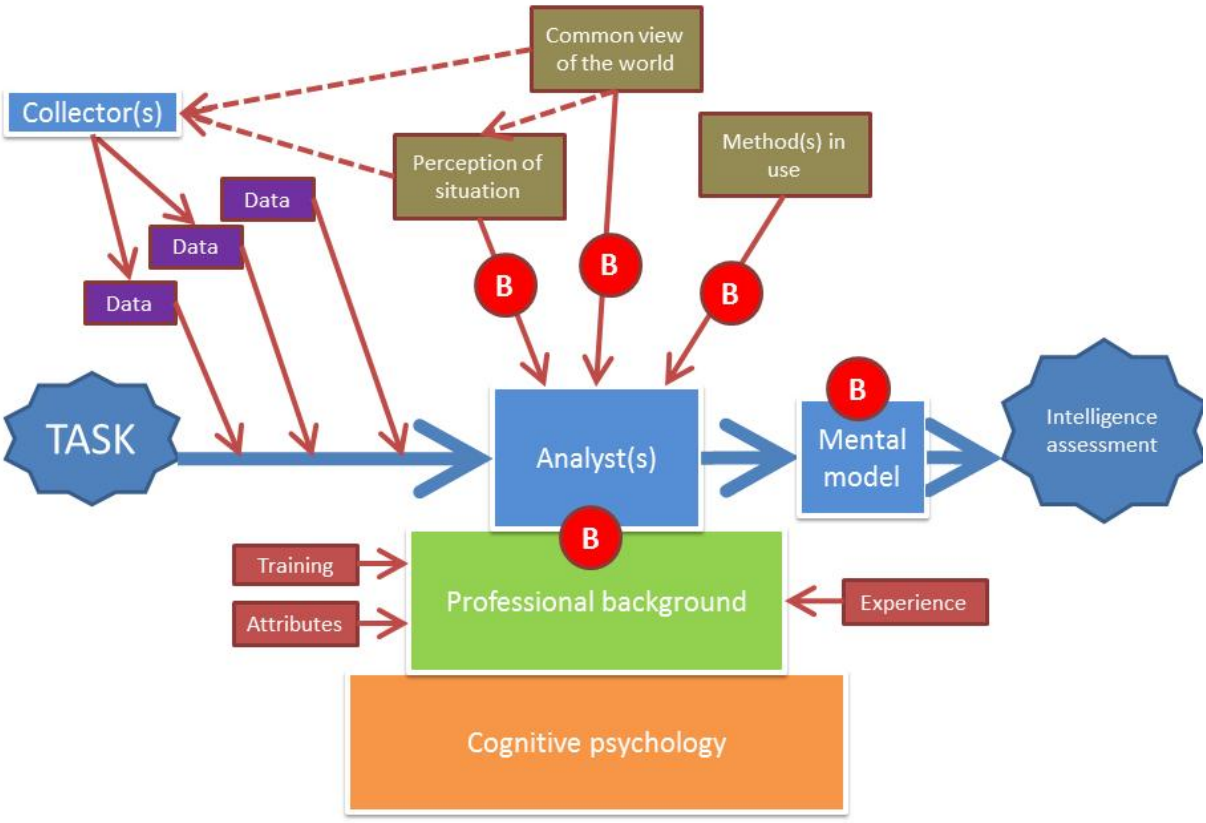

Figure 1. Framework

The framework of the thesis is presented in figure one. The basis of the thesis is formed on human actor - the analyst(s). The main framework is cognitive biases, or cognitive psychology as a broader field that affect the human actor.[28] The analyst(s) can be seen as a pyramid structure, with the founding block being cognitive psychology. On top of this block is the professional background of the analyst(s). The analyst(s) conducting the task is the summit of the pyramid, being built on the lower building blocks. The secondary framework is the intelligence process, which focuses on the part of analysis within the intelligence cycle[29], which is situated within the primary framework of cognitive psychology. Within the framework, the process can be seen moving from left to right: starting from the task, ending with the assessment.[30] Potential phases where cognitive biases may affect the process are marked with the red circle enclosing a capital "B". Two exercises that were used for the case study provided an environment where intelligence analysis was conducted by the analyst(s) within the organizations being trained.

The hypothesis of this thesis was:

> *Cognitive biases impact intelligence analysis, causing predictable errors, due to the cognitive psychology of the analysts. Selected (but not all) biases can be debiased by recognizing them and by using structured analysts methods to counter them.*

The hypothesis was based on essential published literature, presented in chapter 2.4 and analyzed in more detail in appendix one. While the design of this study did not require a hypothesis, one was formed to allow readers to evaluate the possible biases affecting the author. While the main focus was not to prove or de-prove the hypothesis, it was carried along during the study and is examined in chapter six.[31]

2.3 Methods and structure of study

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[28] Kahneman, Daniel: *Thinking Fast and Slow*, Farrar, Straus and Giroux, New York, 2011.
[29] The intelligence cycle (including different relevant variations of it) is examined in detail in chapter 4.2.
[30] Bruce, James B. & George, Roger Z.: *Analyzing Intelligence: National Security Practitioners' Perspectives.* Second edition. Washington, DC: Georgetown University Press, 2014, p. 4. Also see: Clark, Robert M: *Intelligence Analysis: A Target-centric Approach*, 3rd ed. Washington, D.C., CQ Press, 2010, p. 10. Within the Finnish context, the traditional intelligence cycle is presented in: Sipilä, Joonas, Koivula, Tommi, Mikkola, Olli-Matti and Pulkka, Antti: *Analyysiopas (restricted)*, NDU, Juvenes Print, Tampere, 2017,p. 3.
[31] The significance of a hypothesis is discussed extensively in e.g. Hirsjärvi, Sirkka, Remes, Pirkko and Sajavaara, Paula: *Tutki ja Kirjoita [Research and Write]*, 11th edition, Gummerus Kirjapaino Oy, Jyväskylä, 2005, pp. 149-150 and Schwandt, Thomas A. & Gates, Emily F.: *Case study methodology*, pp. 341-358, in Denzin, Norman K. and Lincoln, Yvonna S. (ed): *The SAGE Handbook of Qualitative Research*, 5th edition, SAGE Publications, Inc., 2018, pp. 348-351.

This study has chosen epistemological positivism as the research philosophy. According to Saunders & co, choosing positivism is a valid choice when the goal is collecting data about an observable reality and searching for regularities and casual relationships to create law-like generalizations. Within this view, reducing the phenomena to the simplest elements is an acceptable approach, which fits the research and methods chosen.[32]

The approach used in this study was abduction. While the structure could suggest using deduction as an approach (moving from theory to data), the uncertainties within the hypothesis allowed forming a more flexible approach when using abduction. This allowed moving back and forth from theory to data flexibly.[33]

The study used a mix of qualitative and quantitative research, with qualitative being the lead approach and quantitative being a supportive approach. Within this study, the most suitable pros of qualitative and quantitative methods were chosen for different phases of the research.[34]

The design of this study was case study. According to Saunders & co, case study explores a research phenomenon within its context. As the aim was to gain a rich understanding of the context and processes being enacted, choosing case study was justified.[35] Robert K. Yin emphasizes the strength of case study, when the aim is to explain "how" or "why" a social phenomenon works. The method is more relevant, when the research questions require an extensive and "in-depth" description of the phenomenon.[36] The procedure of the study is presented in figure two.

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[32] Saunders, Mark, Lewis, Philip & Thornhill, Adrian: *Research Methods for Business Students.* 6th ed. Harlow, Pearson, 2012, p. 134. See also Huttunen, Mika & Metteri, Jussi: *Ajatuksia operaatiotaidon ja taktiikan laadullisesta tutkimuksesta [Thoughts on qualitative research of operational art and tactics]* (translated by author), NDU, Edita Prima Oy, Helsinki, 2008. p. 23, where positivism is examined as a philosophical approach for research within the art of war. Huttunen & co see positivism as a demanding approach, but they also see the benefits. On page 28 Huttunen & co emphasize the importance of collecting data as an observer and not a participant. This is examined in data collection. See also Hirsjärvi et al, 2005, p. 129, where they divide the different types of purposes of research and relevant methods.

[33] Saunders et al (2012), p. 147. This choice means that the research is data driven.

[34] Huttunen & Metteri (2008), p. 38. Originally in Finnish, translated by the author. The pros and cons of qualitative and quantitative research have been debated by Huttunen & Metteri connected to the research of a military (tactical level) process. Also see Creswell, John W. & Vicki L. Plano Clark: *Designing and Conducting Mixed Methods Research.* 3rd ed., Sage Publications, Inc., 2018, p.174-175, where they recommend procedures for mixed methods research.

[35] Saunders et al (2012), p. 179. Also see Yin, Robert K.: *Case Study Research - Design and Methods.* 5th ed. Sage Publications, Inc, 2014, pp. 15-17

[36] Yin (2014), p. 4

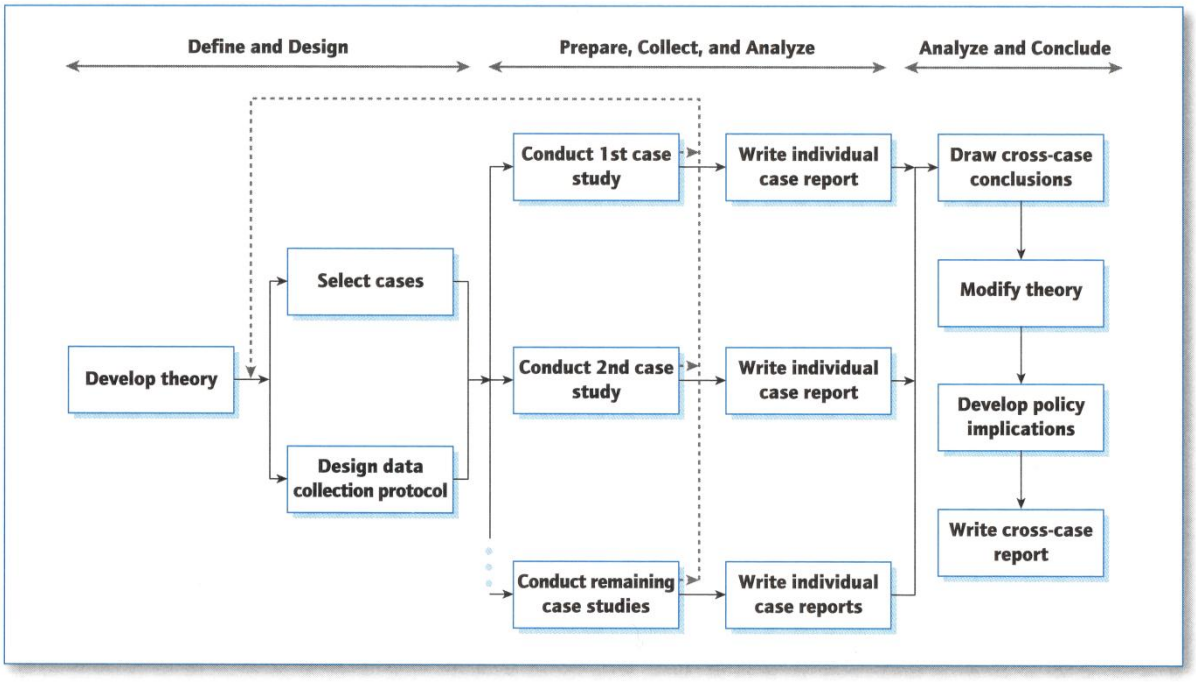

Figure 2. Multiple-Case Study Procedure[37]

The primary phase of the research was the preparation phase, where a meta-analysis[38] of literature on the topic was conducted to build an understanding on the field of cognitive psychology and intelligence analysis. This phase can be described as the "Develop theory" phase presented in figure two. The focus of the literature search was in scientific (peer reviewed) papers covering cognitive biases and intelligence analysis. Google Scholar web search, Science Direct online database searches and EBSCO Discovery Service online database searches were used for initial data collection. As EBSCO alone returned 523,565 peer reviewed results on "cognitive bias", and the Boolean search[39] of ""cognitive bias" AND "intelligence analysis"" returned 125,696 results, it became apparent that the field had been a focus of research recently. A focus was chosen on Richards Heuer's work concerning intelligence analysis[40], and Amos Tversky's and Daniel Kahneman's[41] work concerning cognitive biases due to their pioneer status in the relevant fields and dominance, when observing what studies are citied among the field. At this phase it also became apparent that structured analysis techniques were being widely used to mitigate the effects of cognitive biases within intelligence analysis, so they were added to the initial research problem.

[37] Yin (2014), p. 60
[38] Creswell & Plano Clark (2018), p. 289
[39] Boolean search [https://www.webopedia.com/TERM/B/Boolean_search.html] (21.12.2017)
[40] See e.g. Heuer (2009)
[41] Tversky & Kahneman (1974)

Phase one can be characterized as a means to an end, and not an end in itself. The aim was not to determine the answers about what is known on the topic, but rather to develop sharper and more insightful questions on the topic.[42] This phase also included examination of similar sets of studies, with the aim of reinforcing the relevance and importance of the research question(s).[43] Chapter two of this report was written in phase one.

In the second phase of the study chapters three and four were written. In this phase the material (studies, articles, etc) collected in phase one was meta-analyzed. The content of each document was analyzed to find the scientific principles and logic. Reliability and validity were assessed. After this the material concerning three themes (cognitive biases, intelligence analysis, structured analysis techniques) were compared with each other and conclusions from the synthesis were formed. At this stage a general understanding of the analysis process was reached and data collection protocol for the selected cases was formed. Inquiries concerning the current training given to different professional groups of analysts within the FDF were done in this phase. This was done with the aim of narrowing down the structured analysis techniques that were analyzed within this study to the relevant ones within the selected cases.[44]

The primary empirical data were collected from two selected field exercises in phase three of the research. Returning to phase two was kept as an option after the first case exercise, if the results were found to be unsatisfactory or the hypothesis was found to be flawed.[45] This option was not needed.

Triangulation was used for empirical data collection within the two selected cases to validate the results. The aim was to approach the problem with data from multiple perspectives, thus validating the results. This was done with variations of data collection within the primary method (case study). The type of triangulation used in this study was data triangulation; this meant using different sources of data.[46] The procedure can be summarized as

[42] Yin (2014), pp. 14-15
[43] Ibid, p. 29
[44] The current state of analyst training and relevance to this study is discussed in detail within annex two (restricted). The material obtained was from the Reserve Officer Course, Army Academy and Intelligence School. The material is classified as restricted, which is why it is observed in the annex.
[45] Saunders et al (2012), p. 179. See also Huttunen & Metteri (2008), pp. 44-45 & 127-134. Huttunen & Metteri see case study as a suitable method especially when the research problem concerns a process within a well-defined model. They emphasize the importance of using multiple different types of sources.
[46] Yin (2014), p. 120

"*playing each (sub)method off against the other so as to maximize the validity of field efforts.*"[47] The selected data collection methods within the case exercises were:

- A background questionnaire
- Structured observation
- Comparison of reports made by analysts team and "red-team" actions
- An after-action questionnaire
- A group interview.

The aim of the background questionnaire was to determine the most probable cognitive biases of a single actor as defined in the hypothesis. The questions were designed to categorize the professional background of each analyst. Structured observation was used to observe the selected biases, their effects and the frequency.[48] A unique coding schedule for observation was prepared in phase two.[49] The aim of the coding schedule was also to allow analysis of correlation between the background of the analysts and the biases they succumb onto. As experimentation was not possible with this research design, passive observation was employed to determine if there was a correlation. Regression analysis was used to analyze the data collected.[50]

The after-action questionnaire was designed to collect data on the impression of the actors concerning effecting cognitive biases. The selected biases were shortly presented, after which the analysts were asked to evaluate if they could identify if the bias was present within their own actions or the actions of somebody else within the analysts team. They were also asked to judge the effect (if any) the biases had on them or a team member. Visual analog scales (VAS) were used in this questionnaire as the main method of gathering data from the analysts.[51] The VAS used was a traditional 100 mm long scale.[52] The answers

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[47] Flick, Uwe: *Triangulation*, pp. 444-461, in Denzin, Norman K. and Lincoln, Yvonna S. (ed): *The SAGE Handbook of Qualitative Research*, 5th edition, SAGE Publications, Inc., 2018, p. 446

[48] Huttunen & Metteri (2008), 28. Huttunen & Metteri emphasize the importance of observation when collecting data without participation. They see observation as a valid approach, when the research problem can be defined with a model, where different affecting parts can be defined and observed. Concerning cognitive bias detection, see Nussbaumer, Alexander, Katrien Verbert, Eva-C. Hillemann, Michael A. Bedek & Dietrich Albert: *A framework for Cognitive Bias Detection and Feedback in a Visual Analytics Environment*, IEEE, 2016

[49] Saunders et al (2012), pp. 358-360. The pages describe a good coding schedule for collecting data in observation. This was used for the basis of preparing a unique coding schedule fit for this research.

[50] Cohen, Jacob and Patricia Cohen: *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, 2nd ed. Lawrence Erlbaum Associates, Inc., Publishers, New Jersey, 1983, pp. 13-15, 181-198

[51] The choice of visual analogue scale was influenced by a conference presentation, which examined different continuous scale options: Treiblmaier, Horst and Peter Filzmoser: *Benefits from Using Continuous Rating*

collected from the questionnaire were coded into numbers in accordance with the length of the scale: far left equaled 0, while far right equaled 100.[53] The VAS was chosen, as it is well fitted for researching the opinion or belief of an individual. As a method, it is potentially very sensitive.[54] The potential to repeat this research is also a positive factor for choosing this method for data collection, even if the same individuals happened to be analysts in future research.[55]

A group interview was conducted after a short break after the questionnaire. Within this interview, the researcher presented observations from the exercise concerning biases, and interviewed the actors about their impressions of the effects from these documented biases. The intelligence reports and estimates made by the analyst team were compared to the "red team" plans and actions by the researcher.[56] The questionnaires and coding schedule of observation are presented in annex four.

The goal of the generalization of the results from the empirical data was to expand and generalize theories (analytic generalizations) and not to extrapolate probabilities (statistical generalizations). This goal was dictated by the method of case study; the empirical data collected does not represent a "sample", but rather an experiment. Yin points out that generalizing with the method of case study has been done by notable scientists with *single case studies*; thus the choice of two exercises for this research, which allowed improvement between the *experiments* if needed.[57]

Scales in Online Survey Research, conference presentation from *Thirty Second International Conference on Information Systems*, Shanghai 2011. [https://www.researchgate.net/publication/221598410] (23.10.2018)

[52] Wewers, Mary Ellen and Nancy K. Love: *A Critical Review of Visual Analogue Scales in the Measurement of Clinical Phenomena*, Research in Nursing & Health Volume 13, Issue 4, 1990, pp. 227-228. For more information concerning Visual Analogue Scales, also see e.g.: Physiopedia: Visual Analogue Scale [https://www.physio-pedia.com/Visual_Analogue_Scale] (28.10.2018)

[53] Wewers & Love (1990), pp. 232-234

[54] DeVellis, Robert F.: *Scale Development - Theory and Applications*, 4th ed. Sage Publications, Inc, 2017, pp. 130-132

[55] Ibid, p. 131. Especially the potential advantage of repeating the study favoured VAS over e.g. the Likert scale, which was another obvious candidate. The Likert scale and other similar multiresponse formats however allow participants to potentially remember their previous answers, which is much more difficult when using VAS.

[56] The exercises will be conducted with the computer-based simulator "KESI" (originally based on the German system GESI (Gefechts Simulationssystem) made by CAE). It is possible to review all actions, movements etc by units with the after-action review tool, which will be used to compare actual events especially to "red team" plans. Possibilities and limitations of the simulator within research have been presented by Metteri, Jussi: *Kvantitatiiviset tutkimusmenetelmät operaatiotaidon ja taktiikan tutkimuksessa [Quantitative research methods in research on operational art and tactics]* (translated by author), NDU, Edita Prima Oy, Helsinki, 2006, pp. 75-77.

[57] Yin (2014), pp. 20-21

The two field exercises chosen for gathering the empirical data were computer-aided war-games. They were two-sided, which means that the "red team" conducted its' operation independently and without knowledge of the "blue team's" actions. Thus, the exercises were conducted as realistically as possible. This was especially important when conducting research, where data was being gathered from a military exercise.[58] The choice was also made with access to data considered; the researcher had access needed for this research within the chosen exercises. This access was estimated to most likely illuminate the research questions.[59] The participant's different professional background's within the case exercises was a fruitful aspect of this research.[60]

The fourth phase of the study was the coding and review of data collected from the selected cases. A verbal scale of describing the effects of biases was created to allow a more descriptive written report.[61] Chapters five and six were written during this phase. Final conclusions were reported, critic on the research was judged and further areas of research were identified.

[58] Metteri (2006), p. 48. Metteri emphasizes the importance of keeping the exercises as realistic as possible (as opposed to "gaming", which can be seen as a way of passing time in an entertaining fashion) to make sure the data collected is valid and relevant to the research question(s).
[59] Yin (2014), p. 28
[60] The first exercise was conducted by a training battalion, where participants were a mixture of professional soldiers and conscripts. The second exercise was conducted by the FNDU, where participants were all experienced profession soldiers, who however may not be professionals in the field of analysis. The setup of the exercises is examined in more detail in appendix three.
[61] There is no commonly accepted scale for describing effects in this sort of research, as the needs of different studies differs. Using this sort of verbal description is common with the visual analogue scale (Haefeli, Mathias & Achim Elfering: *Pain assessment* in European Spine Journal, Vol 15, 2006). The descriptive wording used and the numeric steps in this study is based on the wording used for probability assessment in the FDF (*FDF Field Manual 2 - Military intelligence (restricted)* [Kenttäohjesääntö 2 - Sotilastiedustelu (ST IV)] (translated by author), 2015, p.36).

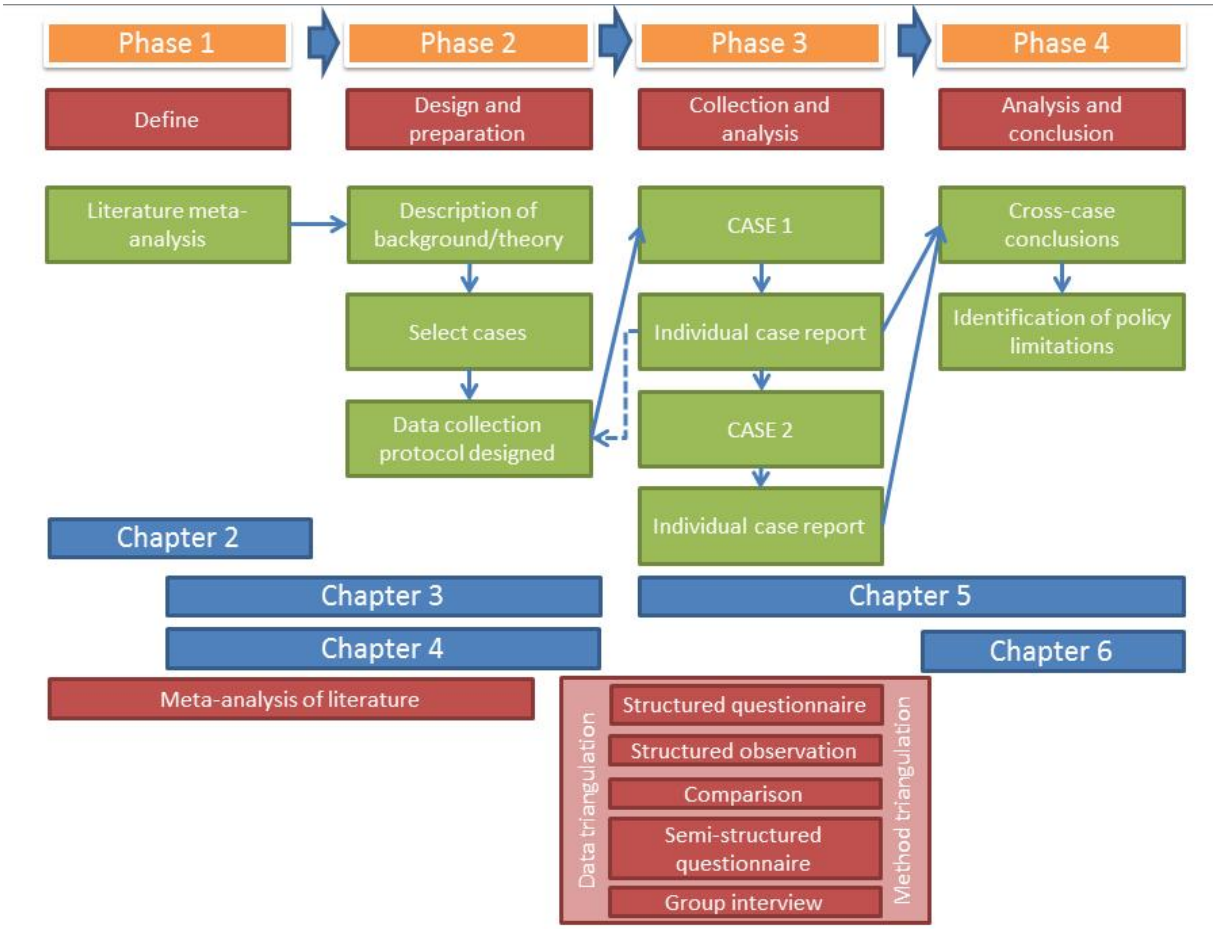

Figure 3. Structure of study

The structure of the study is presented in figure three.[62] The figure is presented with the logic of moving from left to right. The different vertical layers are phase number (orange color), the purpose of the phase (purple), work steps of the study (green), chapter written during the phase (blue), and method used for the phase (purple).

2.4 Research ethics

Promoting responsible conduct of research was an aim of this study. The guidelines are defined by the Finnish Advisory Board of Research Integrity (FABRI).[63] As this study was a thesis for the general staff officer course based on voluntary participation, a research permit was not needed.[64]

[62] The structure has been adopted from Yin's case study structure presented in figure 2 by the author.
[63] TENK: *Responsible conduct of research and procedures for handling allegations of misconduct in Finland - Guidelines of the Finnish Advisory Board on Research Integrity 2012* [http://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf] (20.1.2018)
[64] *Research permits within the Finnish Defense Forces* [Tutkimusluvat puolustusvoimissa] (translated by author). HM751/18.1.2017

The ethical view of this study can be defined by the principles defined by FABRI for research in the humanities, social and behavioral sciences. An ethical review was not needed for this study. All the analysts, whose actions' were being studied, were informed of the study at the beginning of the selected cases. They had the option to refuse taking part in this research. The ethical guidelines were made readily available for the analysts during the cases. The analysts were given the option to submit their email address to the researcher during the cases, which was used to distribute the final thesis to the analysts who wished to receive it.[65]

The data collected within the cases was coded to anonymize the analysts. All data that can be used to recognize the relevant actor was deleted after this, with the coded data used for analysis by the researcher. The anonymized data was permanently stored by the researcher. The list of email addresses was separately stored by the researcher, with the only use of distributing the finished thesis. This list will be destroyed upon the completion of this thesis, after the distribution is done to the willing participants.

2.5 Presentation of source material

Cognitive psychology is a widely studied field internationally. This thesis uses John R. Anderson's book *"Cognitive Psychology and its Implications (8th ed)"* as one of the main sources on the theory of this field. Especially chapters one (basics) and eleven (decision making) are related to this thesis. The author is a Professor of Psychology and Computer Science, and is known for developing ACT-R, which is the most widely used cognitive architecture in cognitive science.[66]

Cognitive biases were first presented in 1974 by Amos Tversky and Daniel Kahneman in their article *"Judgments under uncertainty: Heuristics and biases"*. This article forms the bases of current research on cognitive biases. While the original theory has been developed by the original authors and other scholars after the initial article, it is still valid and forms the starting point of cognitive biases.[67]

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[65] TENK: *Humanistisen, yhteiskuntatieteellisen ja käyttäytymistieteellisen tutkimuksen eettiset periaatteet ja ehdotus eettisen ennakkoarvioinnin järjestämiseksi* [Ethical principles of research in the humanities and social and behavioral sciences and proposals for ethical review] (http://www.tenk.fi/sites/tenk.fi/files/eettisetperiaatteet.pdf, 20.1.2018)

[66] Anderson (2015). This book (including all editions) has been referred to 10396 times within google scholar (4.1.2018).

[67] Tversky, Amos and Daniel Kahneman: *Judgments under uncertainty: Heuristics and biases,* Science (vol 185), 1974

Cognitive biases are widely presented in Daniel Kahneman's book "*Thinking Fast and Slow*" released in 2012. While Kahneman does not handle cognitive biases within intelligence analysis, but rather on a wider perspective, his presentation of different biases and the reasons behind them were used as a starting point of the current view on the matter. Kahneman's book has been used as a source in articles, thesis, and research reports very frequently during the past few years.[68]

Intelligence analysis has been widely researched both internationally and nationally in Finland. The most widely read book on cognitive biases within intelligence analysis is Richards J. Heuer, Jr.'s "*Psychology of Intelligence Analysis*". Heuer presents the practical problems of analyzing intelligence within his book. He presents tools for thinking and cognitive biases. He also presents his conclusions on improving intelligence analysis.[69]

Stephen Marrin's "*Improving Intelligence Analysis*" focuses on improving intelligence analysis with the use of academic scholarship. In the book he sums ten years of work on methods and processes of intelligence analysis and how they can be improved. The book is written from the view of how the CIA handles intelligence analysis.[70]

Roger Z. George and James B. Bruce have edited the book "*Analyzing Intelligence - National Security Practitioner's Perspectives*". The book is a collection of articles by multiple authors, which cover topics such as what intelligence analysis is, what leads to intelligence failures, and techniques and methods on how to counter potential hazards. While to viewpoint is more in the strategic field of intelligence, it offers a valuable source on intelligence analysis and how it is being developed.[71]

Richards J. Heuer Jr and Randolph H. Pherson have published the book "*Structured Analytic Techniques for Intelligence Analysis*", which presents multiple different analytic tech-

[68] Kahneman (2011). The book has been referred to 14041 times within google scholar (4.10.2017).
[69] Heuer (1999). In the final chapter of the book, Heuer offers a checklist for analysis. He presents this as a tool for avoiding "mines" during the process of analyzing data. His emphasis is within the psychology (mental process) of analysis. The book can be seen as a guideline within intelligence analysis. It has been referred to 1272 times within google scholar (29.9.2017).
[70] Marrin, Stephen: *Improving Intelligence Analysis: Bridging the Gap between Scholarship and Practice*. Milton Park, Abingdon, Oxon, [England]; New York: Routledge, 2011. The book has been referred to 52 times within google scholar (4.10.2017).
[71] George, Roger Z & James B Bruce: *Analyzing Intelligence: National Security Practitioners' Perspectives*. Second edition. Washington, DC: Georgetown University Press, 2014. The book has been referred to 7 times within google scholar (4.10.2017).

niques and argues their pros and cons in different situations. It is written for intelligence analysts, who are already familiar with basic analysis.[72]

There are numerous other publicly available books concerning intelligence analysis. They were used when needed to further describe the frame of intelligence analysis and different methods used to improve the intelligence products.[73] Finnish books and field manuals concerning intelligence and intelligence analysis were also available. They were however classified as restricted or higher, so their uses within the unclassified parts of this thesis were limited. They were however used in the classified appendixes of this thesis.[74]

Numerous other publications concerning cognitive psychology, cognitive biases and intelligence analysis are gathered primarily through scientific databases available online. These publications include a vast number of different scientific disciplines, as cognitive biases affect every aspect of human existence where decisions are made. A more comprehensive list of used sources is presented in appendix one. This appendix also includes critical evaluation of the used sources. The evaluation was done by examining the sources nature, quality, relevance etc.[75]

The empirical source data collected within this research is presented in chapter five and appendixes five and six.[76]

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[72] Heuer, Richards J. & Randolph H. Pherson: *Structured Analytic Techniques for Intelligence Analysis*. 2nd. ed. Washington, DC: CQ Press, 2014. The book has been referred to 233 times within google scholar (4.10.2017).

[73] Examples of these books: Beebe, Sarah Miller & Randolph H. Pherson: *Cases in Intelligence Analysis: Structured Analytic Techniques in Action*, Second edition, Los Angeles, Sage, 2015; Clark, Robert M: *Intelligence Collection*, Washinton, DC, Sage/CQ Press, 2013; Clark, Robert M: *Intelligence Analysis: A Target-centric Approach*, 3rd ed. Washington, D.C., CQ Press, 2010; Fingar, Thomas: *Reducing Uncertainty: Intelligence Analysis and National Security*, Stanford, California, Stanford Security Studies, 2011; Lowenthal, Mark M: *Intelligence: From Secrets to Policy*, 7th ed., Stanford, California, Stanford Security Studies, 2017; Moore, David T: *Critical Thinking and Intelligence Analysis*, Washington, DC, National Defense Intelligence College Press, 2009; Pherson, Katherine Hibbs & Randolph H. Pherson: *Critical Thinking for Strategic Intelligence*, Thousand Oaks, California, CQ Press, 2016; Prunckun, Hank: *Scientific Methods of Inquiry for Intelligence Analysis*, Second Edition, Lanham, Maryland, Rowman & Littlefield, 2014; Walsh, Patrick F: *Intelligence and Intelligence Analysis*, New York, NY, Routledge, 2011.

[74] Finnish field manuals were analyzed while observing the field exercises in phase 3 and when analyzing the data in phase 4 of the research process, despite their classification.

[75] The evaluation is aided with information from the Publication Forum [https://www.tsv.fi/julkaisufoorumi/haku.php?lang=en], scientific databases (e.g. Scopus, Ebsco, Google scholar, Science direct) etc.

[76] More detailed collected (raw) data (e.g. audio files, event reports etc) are in the possession of the researcher and available on request.

3 COGNITIVE PSYCHOLOGY AND COGNITIVE BIASES

"There is a fine line deep within the mind that makes self-belief and confidence, the defining elements of success and failure in any circumstance. How we learn to activate them without running the risk of lying to ourselves is the key that unlocks the superhuman lying dormant within us."- David Amberland[77]

This chapter provides the reader an overview of the framework of this thesis: cognitive psychology and cognitive biases. First, cognitive psychology is defined and briefly described in subchapter 3.1. The chapter ends with the introduction of *Dual process theory*.

Subchapter 3.2 describes cognitive biases in accordance with Kahneman's and Tversky's original division of three heuristics. The five cognitive biases chosen as a focus for this research are defined and described at the end of the relevant subchapters. Subchapter 3.3 describes the impact of biases have on intelligence analysis. The choice of the five cognitive biases relevant for this research are justified in this subchapter. Subchapter 3.4 and its' further subchapters present the five chosen biases.

The chapter ends with a summary of cognitive psychology and cognitive biases and their relevance for this study. The aim of this chapter is to allow the reader to better understand the choices made by the researcher concerning research study, and to provide the reader a sufficient understanding of the framework of this thesis. The thesis' research sub question one (*What cognitive biases are most probably present within two selected cases?)* is answered in this chapter. The basis for answering sub questions two (*How do the professional backgrounds of analysists affect the impact of cognitive biases?)* and three (*How do cognitive biases affect the intelligence analysis in two selected cases?)* are presented in this chapter.

3.1 Cognitive psychology

Cognitive psychology is the science of how the mind is organized to produce intelligent thought and how the mind is realized to the brain.[78] The practical implications of this field

[77] Amberland, David: *The Sniper Mind: Eliminate Fear, Deal with Uncertainty, and Make Better Decisions*, St. Martin's Press, 2017
[78] Anderson (2015), p. 1

of science have been a wide point of interest especially since the 1950's[79], accelerating in the 1990's.[80] As a new field of science, major advancement has been made in the last twenty years, making the field both interesting and worthwhile to research. The base of this field of science however is not new, as the origins can be traced to ancient Greeks Plato and Aristotle.[81]

The context of problem solving within humans provides a base for understanding how we tackle problems; understanding this allows the process to be analyzed and improved. Within cognitive psychology, problem solving is often described in terms of searching a problem space, which consists of various states of the problem. A state is a representation of the problem in some degree of solution. The initial situation of the problem is referred to as the start state; the situations on the way to the goal, as intermediate states; and the goal, as the goal state.[82] Anderson states that successful problem solving depends on representing problems in such a way that appropriate operators can be seen to apply.[83]

Acquiring expertise within a particular field (i.e. intelligence analysis) is a multistage process, which generally takes at least ten years.[84] The development of a skill into expertise can typically be characterized as passing through three stages. The first stage is the cognitive stage. In this stage, participants develop a declarative encoding of the skill; that is, they commit to memory a set of facts relevant to the skill. The second stage is called the associative stage, where two main things happen. First, errors in the initial understanding are gradually detected and eliminated. Second, the connections among the various elements required for successful performance are strengthened. The third stage is the autonomous stage, in which the procedure becomes more and more automated and rapid.[85]

Judgement under uncertainty, or applying an individual's expertise in analysis to a given situation containing uncertainties was studied by Amos Tversky and Daniel Kahneman. They showed that people rely on a limited number of heuristic principles which reduce the

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[79] Hilbert, Martin: *Toward a Synthesis of Cognitive Biases: How Noisy Information Processing Can Bias Human Decision Making* in *Psychological Bulletin*, Vol. 138, No. 2, 2012, pp. 211-237

[80] For more information on practical studies on human error within the field of experimental psychology , see e.g. Reason, James: *Human Error,* New York, Cambridge University Press, 1990, pp.19-52

[81] Anderson (2015), pp. 4-5

[82] Ibid, p. 183

[83] Ibid, p. 201. Anderson gives numerous examples of how the presentation of the problem affects the ability of a test group to solve the problem, see pp. 199-203

[84] Ibid, p. 210. Also see Hayes, John R: *Three problems in teaching skills* in Segal J., Chipman S. & Glaser R. (ed): *Thinking and learning (Vol 2)* (pp. 391-406), Erlbaum, Hillsdale, NJ, 1985

[85] Anderson (2015), pp. 211-212. Also see Fitts, P.M. & M.I. Posner: *Human performance,* Brooks Cole, Belmont, Ca, 1967

complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics were shown to be quite useful, but sometimes they lead to severe and systematic errors. These errors are called cognitive biases.[86] There is critical research concerning heuristics: one well known author is Gerd Gigerenzer, who criticizes heuristics as being oversimplified.[87] He argues that "heuristics and biases" is an important transitional stage, which needs to be transformed for long-term progress to be made.[88]

Tversky's and Kahneman's original findings were evolved into the *Dual process theory*, which has become a predominant approach on human judgment. The theory poses two systems of decision making called System 1 and System 2. The difference between the systems is intuitive versus analytical thinking. System 1 is intuitive, fast, efficient, and often unconscious. It draws on available knowledge and past experience. It is based on a long-established mental model of how people or things work in a specific environment. The thinking requires little effort and allows people to solve problems quickly and efficiently. While often accurate, it is also the common source for cognitive biases. System 2 is analytic thinking. It requires more effort, and is slow, deliberate, and conscious reasoning.[89]

3.2 Cognitive biases

The original approach of heuristics and biases was launched by Tversky and Kahneman in the early 1970s.[90] The approach has evolved after this, as it has been widely studied within social science in general.[91] The term "bias" was originally used to describe a slanting line (e.g. the diagonal in a square). The modern use of the word describes deviations from a

[86] Tversky & Kahneman (1974), p. 1124
[87] Gigerenzer, Gerd: *Fast and Frugal Heuristics: The Tools of Bounded Rationality* in Koehler, Derek J., and Nigel Harvey (eds.): *Blackwell Handbook of Judgment and Decision Making*, Blackwell pub., Oxford, UK ; Malden, MA, 2004, pp. 62-84. Gigerenzer has numerous publications concerning the topic, which can be found in the referred article.
[88] Gigerenzer, Gerd: *How to Make Cognitive Illusions Disappear: Beyond "Heuristics and Biases* in *European Review of Social Psychology*, Vol. 2, 1991, pp. 83-115, p. 86 . It is worthwhile to note that Gigerenzer's criticism caused academic debate between different schools of thought. See e.g.: Kahneman, Daniel & Amos Tversky: *On the Reality of Cognitive Illusion*, in *Psychological Review*, Vol. 103, No. 3, 1996, pp. 582-591. This article also includes a postscript responding the Gigerenzer's reply to the article.
[89] Heuer & Pherson (2014), p. 4. Also see Evans, Jonathan & Keith Frankish: *In Two Minds: Dual Processes and Beyond*, Oxford University Press, Oxford, U.K., 2009
[90] Tversky & Kahneman (1974), p. 1124
[91] Keren, Gideon and Karl H. Teigen: *Yet Another Look at the Heuristics and Biases Approach* in Koehler, Derek J., and Nigel Harvey (eds.): *Blackwell Handbook of Judgment and Decision Making*, Blackwell pub., Oxford, UK ; Malden, MA, 2004, 89-90. Also see Wilke, A and R Mata: *Cognitive Bias* in V.S. Ramachandran (ed.): *The Encyclopedia of Human Behavior, vol. 1,* 2012, pp. 531-535

norm, or it indicated a tendency to slant in one way rather than another.[92] Within the field of psychology, a bias is rather conceived as an effect than a cause.[93]

Biases can be the result of cognitive limitations, processing strategies, perceptual organizing principles, an egocentric perspective, specific motivations, affects and cognitive styles. In heuristics and biases tradition, the general approach has been regard biases as a more or less regular by-product of some more general principles of judgment (labeled heuristics).[94] The research concerning biases has been generalized to the whole area of judgment and decision making in the early 1990s.[95] A current generalized definition of cognitive bias: "*A cognitive bias refers to the systematic pattern of deviation from norm or rationality in judgment, whereby inference about other people and situations may be drawn in an illogical fashion."*[96]

According to the *Dual process theory*, cognitive biases are mostly produced by System 1 thinking. System 2 thinking is used to counter the biases and other intuitive mistakes caused by the intuitive thinking of System 1. Heuer goes as far as claiming that all biases, expect the personal self-interest bias, are the result of System 1 thinking.[97]

The number of recognized biases currently has risen up to 175. While there are duplicates within this number, it illustrates the amount of research directed into the field since Tversky's and Kahneman's original research.[98]

Cognitive biases are difficult to overcome, even if the person is aware of the bias affecting. Heuer notes: "*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*

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[92] Keren & Teigen (2004), p. 91
[93] Ibid, p. 92
[94] Keren & Teigen (2004), p. 92
[95] Ibid, p. 95
[96] Haselton, M. G.; Nettle, D. & Andrews, P. W.: *The evolution of cognitive bias*, in D. M. Buss (Ed.), *The Handbook of Evolutionary Psychology*: Hoboken, NJ, US: John Wiley & Sons Inc., 2005, pp. 724–746. Another definition is: *Systematic error in judgment and decision-making common to all human beings which can be due to cognitive limitations, motivational factors, and/or adaptations to natural environments.* (Wilke & Mata (2012), p. 531)
[97] Heuer & Pherson (2014), p. 5
[98] Benson, Buster: *Cognitive bias cheat sheet* [https://betterhumans.coach.me/cognitive-bias-cheat-sheet-55a472476b18] 4.1.2018. The blog illustrates recognized biases in a diagrammatic picture, a visually easy way to grasp the biases and their internal connections. Also see *Psychology Wiki: List of biases in judgment and decision making* [http://psychology.wikia.com/wiki/List_of_biases_in_judgment_and_decision_making] 29.6.2018, which lists 168 different cognitive biases (including references).

not produce a more accurate perception".[99] The analogy between biases and optical illusions can be illustrated with the Müller-Lyer illusion presented below in figure four. People tend to see the three horizontal lines as being different lengths. Despite knowing that the horizontal lines are of the same length, the illusion of different lengths remains. Cognitive biases work in the same fashion: despite knowing a fact, an impression may try to overcome this knowledge.[100]

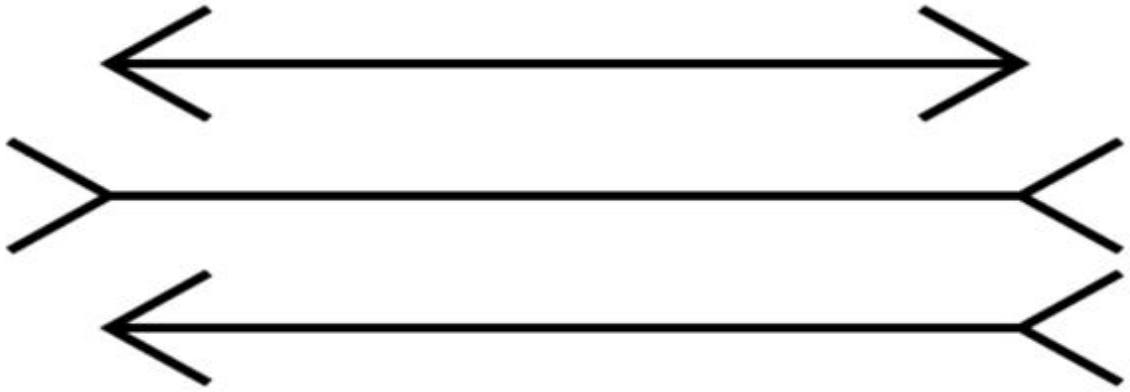

Figure 4. The Müller-Lyer illusion[101]

Tversky and Kahneman originally described biases under three judgmental heuristics: representativeness, availability, and anchoring and adjustment.[102] While they were not introduced as the only three (or even most important three) heuristics, they have since occupied a unique position as "prototypical" within the field of research.[103] Later research has produced critic on the unison of heuristics and biases, stating that the impression given by Tversky and Kahneman is that heuristics has the main task of producing biases, and that any bias was to be explained by corresponding heuristic.[104] The intelligence community has recently focused on applications of *Judgement and Decision Making*, which contends Tversky and Kahneman's view of heuristics leading to cognitive biases.[105] Alternative per-

[99] Heuer (1999), p. 112
[100] Kahneman (2011), p. 29
[101] Originally presented by: Müller-Lyer, FC: *Optische Urteilstäuschungen*, Archiv für Physiologie Suppl, 1889, pp. 263–270. Redrawn by author for this thesis.
[102] Tversky & Kahneman (1974)
[103] Koehler, Derek J., and Harvey, Nigel: *Blackwell Handbook of Judgment and Decision Making*, Blackwell pub., Oxford, UK ; Malden, MA, 2004, p. 95
[104] Ibid, p. 101. Also see Fiedler, Klaus: *On the testability of the availability heuristic* in Scholz, R. W. (ed): *Decision Making Under Uncertainty* (pp. 109-119), North-Holland, Amsterdam, 1983; Gigerenzer, G., Todd, P.M. & The ABC Research Group: *Simple Heuristics that Make us Smart*, Oxford University Press, Oxford, U.K., 1999; Lopes, Lola L.: *The rhetoric of irrationality* (65-82) in *Theory and Psychology 1*, 1991; and Fiedler, Klaus & Momme von Sydow: *Heuristics and biases: Beyond Tversky and Kahneman's (1974) judgment under uncertainty*, 2015
[105] Puvathingal, Bess J. & Donald A. Hantula: *Revisiting the Psychology of Intelligence Analysis - From Rational Actors to Adaptive Thinkers* in *American Psychologist*, Vol. 67, No. 3, 2012

spectives have included *Naturalistic Decision Making*, where researchers explore *"real"* decisions within e.g. military[106], firefighting[107] and law enforcement[108]. Biases will be examined in the following subchapters under the three heuristics as presented by Tversky and Kahneman in 1974.

3.2.1 Biases related to representativeness

The representativeness heuristic is used when making judgments about the probability of an event under uncertainty. Tversky and Kahneman experimented *insensitivity to prior probability of outcomes* with probabilities and descriptions, giving a test group probabilities of 0,3 and 0,7 of a person being a lawyer or an engineer. The subject group correctly used the prior probabilities in the test (according to Bayes' rule), if given no other information. However, they proved that subject groups ignored prior probabilities when given a description, even if this was totally uninformative, leading to incorrect results.[109]

Insensitivity to sample size was tested by Tversky and Kahneman by having test groups evaluate the probability of a small sample deviating from an average value compared to a large sample. Test subjects failed to appreciate the fundamental rules of statistics, which states that large samples are less likely to stray from averages.[110]

Misconceptions of chance was tested by having a test group evaluate the probability of a sequence to appear in a short test of tossing a coin. The test showed that subjects regarded the sequence H-T-H-T-T-H[111] to be more likely that the sequence H-H-H-T-T-T, which does not appear random, and also more likely than the sequence H-H-H-H-T-H, which does not represent to fairness of the coin. This shows that people expect that the essential charac-

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[106] E.g. Hoffman, Robert R. (Ed.): *Expertise out of context: Proceedings of the Sixth International Conference on Naturalistic Decision Making*, Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers, 2007
[107] E.g. Klein, Gary A.: *Sources of power: How people make decisions*, Cambridge, MA: MIT Press, 2001
[108] E.g. Alison, Laurence, Emma Barrett & Jonathan Crego: *Criminal investigative decision making: Context and process* in R. R. Hoffman (Ed.): *Expertise out of context: Proceedings of the Sixth International Conference on Naturalistic Decision Making* (pp. 79–95),.Mahwah, NJ: Erlbaum, 2007
[109] Tversky & Kahneman (1974), pp. 1124-1125. For more recent research on this heuristic, see e.g. Haselton, Martie G. & David C. Funder: *The evolution of Accuracy and Bias in Social Judgment*, pp. 14-38 in Schaller, Mark, Jeffry A. Simpson & Douglas T. Kenrick (eds.): *Evolution and Social Psychology*, Psychology Press, 2013
[110] Tversky & Kahneman (1974), p. 1125. Also see further development of the use of this bias in politics: Arceneaux, Kevin: *Cognitive Biases and the Strength of Political Arguments* in *American Journal of Political Science*, Vol. 56, No. 2, 2012, pp. 271-285
[111] The test uses the abbreviations H for heads and T for tails describing sides of a coin.

teristics of the process will be represented not only statistically in a long sequence, but also in a sample, or short sequence.[112]

Insensitivity to predictability was tested by asking a test group to evaluate the future profit of a company with only a description of the company as a basis. If the description was very favorable, a very high profit will appear most representative of that description; if mediocre, then mediocre profits will appear most representative. The degree to which the description is favorable is unaffected by the reliability of how it permits accurate prediction. Statistical theory states that if the descriptions provide no relevant information to profit, then the same prediction should be made for all companies.[113]

The illusion of validity means that people tend to predict by selecting the outcome that is most representative of the input. This was tested by describing a person as a librarian; if the description matched the stereotype of a librarian, then people had large confidence in the description, even if the description was scanty, unreliable or outdated.[114]

Misconceptions of regression means that people do not develop correct intuitions about regression and statistics. This is caused when they do not expect regression in many contexts where it is bound to occur, and even when they recognize the occurrence of regression, they often invent spurious casual explanations for it.[115]

3.2.2 Biases related to availability

The availability heuristic is a mental shortcut that relies on immediate examples that come easily to a person's mind under specific circumcises. This leads to predictable biases. *Biases due to the retrievability of instances* are caused when more easily accessible instances are presented. In a test, Tversky and Kahneman gave a list of names, asking test groups to evaluate if there were more male or female names on the list. If the list consisted of more well-known male personalities, then subjects erroneously judged that there were more male names.[116]

[112] Tversky & Kahneman (1974), pp. 1125-1126
[113] Tversky & Kahneman (1974), p. 1126
[114] Ibid, p. 1126
[115] Ibid, pp. 1126-1127
[116] Ibid, p. 1127

Biases due to the effectiveness of a search set was tested by asking a test group if a word is more likely to start with a letter "r" than having it as the third letter. Because it is much easier to search for words that begin with a given letter, most subjects judged that words beginning with the letter "r" are more frequent, while actually words having the letter "r" as the third letter are more frequent.[117]

Biases of imaginability occurs when one has to assess the frequency of a class whose instances are not stored in memory but can be formed using a given rule. Typically is such situations, one generates several instances and evaluates frequency or probability by the ease with which the relevant instances can be constructed. However, the ease does not automatically reflect to the actual frequency, causing error.[118]

Illusory correlation is a bias in the judgment of the frequency two events will co-occur. It is based on the strength of association of two events; if the strength is strong, then it is likely that one will conclude that the events will co-occur, despite the actual correlation. In general, instances of large classes are recalled better and faster than instances of less frequent classes, making the associative connections between frequent events stronger. While this is a valuable estimation procedure, it also leads to systematic errors.[119]

3.2.3 Biases related to adjustment and anchoring

The heuristic of adjustment and anchoring is a mental shortcut, where people make estimates by starting from an initial value that is adjusted to yield the final answer. The starting point may be suggested by the formulation of the problem, or may result of partial computation. While useful, adjustments are typically insufficient, causing a bias with the final value.[120]

Insufficient adjustment is demonstrated by asking subjects to estimate various quantities (e.g. the percentage of African countries in the United Nations). For each quantity, a number between 0 and 100 was randomly chosen in the subjects' presence. After this, the subject was initially instructed to indicate whether the number was higher or lower than the value of the quantity, and then to estimate the value by moving upward or downward from

[117] Ibid, p. 1127
[118] Tversky & Kahneman (1974), pp. 1127-1128
[119] Ibid, p. 1128
[120] Ibid, p. 1128

the given number. Different groups were given different numbers, showing that the arbitrary numbers had a marked effect of estimates. Anchoring also occurs when the subject bases an estimate on a incomplete conclusion. A test group was asked to estimate the result of:

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$$

While another group estimated the product of:

$$8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$$

The groups were given five seconds to reply with a numerical estimation. To rapidly answer such questions, people may perform a few steps of computation and estimate the product by extrapolation or adjustment. The median estimate for the ascending sequence was 512, while the median estimate for the descending sequence was 2,250. The correct answer is 40,320.[121]

Biases in the evaluation of conjunctive and disjunctive events was tested by giving subjects the opportunity to bet on one of two events. Three types of events were used:

1. Simple events, such as drawing a red marble from a bag containing 50% red marbles (probability 50%).
2. Conjunctive events, such as drawing a red marble seven times in succession (with replacement), from a bag containing 90% red marbles (probability 48%).
3. Disjunctive events, such as drawing a red marble at least once in seven successive tries (with replacement), from a bag containing 10% red marbles (probability 52%).

Results showed that a significant majority preferred to bet on the conjunctive event rather than on the simple event. Subjects also preferred to bet on the simple event rather than the disjunctive event. Thus, most subjects bet on the less likely event in both comparisons, showing a general finding of thought pattern: people tend to overestimate the probability of conjunctive events and underestimate the probability of disjunctive events.[122]

[121] Tversky & Kahneman (1974), p. 1128
[122] Ibid, pp. 1128-1129

Anchoring in the assessment of subjective probability distributions is a phenomenon where subjects state overly narrow confidence intervals, which reflect more certainty than is justified by their knowledge about the assessed quantities. This is caused, in part at least, to anchoring. It was tested by presenting 24 quantities to a group of subjects, who assess either X_{10} or X_{90} for each problem. Another group was then given the median judgment of the first group for the 24 quantities and asked to assess the odds that each of the given values exceeded the true value of the relevant quantity. In absence of any biases, the second group should retrieve the odds specified to the first group (9 : 1 in this example). However, if the stated values served as anchors, the odds of the second group should be less extreme, closer to 1 : 1. The median odds stated by the second group were 3 : 1. When tested, the results of the first group were too extreme, and the results of the second group were too conservative.[123]

3.3 The impact of biases in intelligence analysis

Richards Heuer's work for the US intelligence community in the 1970's and 1980's, followed by his book *Psychology of Intelligence Analysis,* applied Tversky and Kahneman's insights to problems encountered by intelligence analysts.[124] Other authors have continued Heuer's work within the US intelligence community, especially after the publishing of his book. Jeffrey Cooper identifies cognitive biases as a major cause of analytic failure within the intelligence community. He identifies the psychological hindrances to making accurate judgements by individuals and small groups as an institutional flaw, which requires improvement within the analytical process.[125]

Rob Johnston has studied the analytic culture within the US intelligence community. He also identifies cognitive biases as a major cause of analytic failure. He remarks on the issue of workload and lack of time the analysis have. He reports comments from analysts, which shows how these factors lead to cognitive biases affecting the reports: *"I don't have time to worry about formal analytic methods. I've got my own system. It's more intuitive and faster."; "Alternative analysis is a nice concept, but I don't have the time to do it. I've got to keep up with the daily traffic."*[126] Johnston also notes that analysts see their profession as a

[123] Tversky & Kahneman (1974), pp. 1129-1130
[124] Heuer (1999)
[125] Cooper, Jeffery R.: *Curing Analytic Pathologies- Pathways to Improved Intelligence Analysis,* The Center of the Study of Intelligence (CSI), Washington, DC, 2005, pp. 6-7, 48, 55
[126] Johnston, Rob: *Analytic Culture in the U.S. Intelligence Community: An Ethnographic Study*, The Center of the Study of Intelligence (CSI), Washington, DC, 2005, pp. 34-35

tradecraft rather than science. He concludes that the quality of any tradecraft depends on the innate cognitive capabilities of the individual and the good fortune one has in finding a mentor who has discovered methods that seem to be effective. This differs from science in the matter that within tradecraft, the disciplines often occur without being tested or validated.[127] This makes the tradecraft susceptible to cognitive biases.[128]

As there are over 175 recognized biases[129], a problem analysts encounter is how to recognize the most probable effecting biases, with the aim of mitigating the effects. While actually listing all known biases is not relevant, the cause and effect of the systematic error causing them is. Richards Heuer does not list most probable biases, but rather presents the root cause of biases: the vividness of information, absence of evidence, oversensitivity to consistency, evidence of uncertain accuracy, persistence of primary impressions, favoring casual explanations, favoring perception of centralized direction, similarity of cause and effect, overestimating internal impact or self-importance, illusionary correlation, difficulty of estimating probabilities, and hindsight.[130] Katherine and Randolph Pherson continue research on most probable biases. They have identified five biases that can most probably impede analytic thinking: Confirmation bias, Evidence acceptance bias, Hindsight bias, Mirror imaging, and Vividness bias.[131] A study by RAND Corporation[132] identifies four chief biases within intelligence analysis: Confirmation bias, mirror imaging, anchoring, and groupthink.[133] Jack Davies goes even further, and focuses on only two most probable biases: Confirmation bias and Mirror imaging.[134]

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[127] Ibid, p. 40

[128] There have also been studies in which e.g. visual presentation of data is used to debias intelligence analysis (E.g.: Cook, Maia B. & Harvey S. Smallman: *Human Factors of the Confirmation Bias in Intelligence Analysis: Decision Support From Graphical Evidence Landscapes* in *Human Factors,* Vol. 50, No. 5, 2008, pp. 745-754 and Wall, Emily, Leslie M. Blaha, Lyndsey Franklin & Alex Endert: *Warning, Bias May Occur: A proposed Approach to Detecting Cognitive Bias in Interactive Visual Analytics*, IEEE, 2017) or ontology model created to support cognitive bias assessment, with the aim of reducing biases (E.g.: Lortal, Gaëlle, Philippe Capet & Alain Bertone: *Ontology Building for Cognitive Bias Assessment in Intelligence,* RECOBIA project conference paper, 2014)

[129] Benson (2018)

[130] Heuer (1999), pp. 115-171. The causes of biases are listed in the order Heuer handles them in the book. While Heuer does not name the biases that are caused by these reasons or conditions, they are a valid starting point for choosing most important biases.

[131] Pherson & Pherson (2016), pp. 54-56

[132] RAND Corporation is a nonprofit research organization formed in 1948.

[133] Artner, Stephen, Richard S. Girven & James B. Bruce: *Assessing the Value of Structured Analytic Techniques in the U.S. Intelligence Community*, RAND Corporation, 2016, p. 2

[134] Davies, Jack: *Why Bad Things Happen to Good Analysts* in Bruce, James B. and Roger Z. George (eds): *Analyzing Intelligence: National Security Practitioners' Perspectives.* Second edition. Washington, DC: Georgetown University Press, 2014, pp. 123-127

There are however also contradictory studies about the effect of cognitive biases, though not as numerous or well-known as studies emphasizing the need to mitigate biases in intelligence analysis. Wheaton conducted a study, where he compared groups on an analysis task, with groups differing in the techniques to mitigate biases and a control group not using efforts or techniques to mitigate the biases. His conclusion was that reducing biases in intelligence analysis is not enough and may not be important at all. Within the study the group that produced the most accurate analysis was actually the most biased group. Thus "*a less biased forecast is not necessarily a more accurate forecast."*[135]

3.4 Biases selected for further research

Five cognitive biases were selected for this research. They were: *Confirmation bias, Mirror imaging, Vividness bias, Group thinking bias,* and *Anchoring effect*. The selection was based on literature presented in the previous chapter, and also by an evaluation by the researcher on how the selected bias could be studied with the methods selected for this research. Biases that the researcher evaluated could not be studied with the methods selected were discounted from the selection. In the following subchapters, each bias will be defined, and the phenomenon causing the bias including relevant prior research will be briefly presented.

3.4.1 Confirmation bias

The confirmation bias was first discovered in its' current form by J. C. Wason in a study published in 1960.[136] There has however been knowledge of the effects of confirmation bias, which can be tracked back to the 17th century.[137] It is also known as the *myside bias*[138], *confirmatory bias,*[139] *verification bias*[140] and *congruence bias*[141]. The definition chosen to

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[135] Wheaton, Kristan J.: *Reduce Bias In Analysis: Why Should We Care? (Or: The Effects Of Evidence Weighting On Cognitive Bias And Forecasting Accuracy)*, [http://sourcesandmethods.blogspot.fi/2014/03/reduce-bias-in-analysis-why-should-we.html], 4.1.2018. Wheaton is an associate professor in intelligence studies at Mercyhurst University, with 20 years of experience in military intelligence.
[136] Wason, Peter Cathcart: *On the failure to eliminate hypotheses in a conceptual task* in *Quarterly Journal of Experimental Psychology*, Vol. 12, No. 3, 1960, pp. 129-140,
[137] Nickerson, Raymond S.: *Confirmation Bias: A Ubiquitous Phenomenon in Many Guises* in *Review of General Psychology*, Vol. 2, No. 2, 1998, pp. 175-220, p. 176
[138] Baron, Jonathan: *Thinking and Deciding*, 4th ed., Cambridge, Cambridge University Press, 2008, p. 195
[139] Rabin, Matthew & Joel L. Schrag: *First Impressions Matter: A Model of Confirmatory Bias* in *The Quarterly Journal of Economics*, Vol. 114, No. 1, 1999, pp. 37-82
[140] Poletiek, Fenna: *Hypothesis-testing behavior*, Psychology Press, 2001, p. 73
[141] Baron (2008), p. 56

be used within this research of the confirmation bias is: "*Only seeking information that confirms our initial decisions, hypothesis, judgements or conclusions ignoring information against them.*"[142] Another commonly used definition is: "*The tendency to search for, interpret, focus on and remember information in a way that confirms one's preconceptions.*"[143] There are numerous variations of the definition[144], but the main focus is that the bias is caused by trying to confirm a person's initial conclusion, or "*a general tendency for people to believe too much in their favored hypothesis"* as Klayman generalizes the bias including its' different definitions.[145]

The confirmation bias is caused by the heuristic of adjustment and anchoring presented in chapter 3.2.3, if using the original approach proposed by Tversky and Kahneman.[146] Later groupings of biases proposed by different researches include categorizing confirmation bias as part of the "interest" -category[147] or as part of the "attention" -category.[148] As the confirmation bias is a very widely researched bias, which could be seen to actually include numerous biases with the same end result, there have been numerous varying reasoning presented behind the cause of the bias.[149] For purposes of this thesis, there is however no need to present the theories behind the phenomenon in more detail, as the focus is on the effects of the bias within intelligence analysis.

3.4.2 Mirror imaging

Mirror imaging can be seen to be among the most challenging obstacles for the intelligence community to overcome.[150] Heuer goes as far as claiming that mirror-imaging is an "*unavoidable cognitive trap*".[151] The definition used for mirror imaging in this thesis: "*Assuming*

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[142] ACAPS: *Cognitive Biases,* 2016 [https://www.acaps.org/sites/acaps/files/resources/files/acaps_technical_brief_cognitive_biases_march_2016.pdf] 12.1.2018, p. 3
[143] Oswald, Margit E. & Grosjean, Stefan: *Confirmation bias* in Pohl, Rüdiger F. (ed.): *Cognitive Illusions. A Handbook on Fallacies and Biases in Thinking, Judgement and Memory*, Psychology Press, 2004, pp. 79-96, p. 79
[144] See e.g.: Nickerson (1998), pp. 175-220 or Cheikes, Brant A., Mark J. Brown, Paul E. Lehner & Leonard Adelman: *Confirmation Bias in Complex Analyses,* MITRE Center for Integrated Intelligence Systems, Bedford, Massachusetts, 2004, pp. 1-3
[145] Klayman, Joshua: *Varieties of Confirmation Bias* in *Psychology of Learning and Motivation*, Vol. 32, 1995, pp. 385-418
[146] Tversky & Kahneman (1974), pp. 1128-1130
[147] Mohanani, Rahul, Iflaah Salman, Burak Turhan, Pilar Rodríguez & Paul Ralph: *Cognitive Biases in Software Engineering: A Systematic Mapping Study,* 2017, pp. 22-23
[148] Baron (2008), p. 56
[149] See e.g. Winter (2018), pp. 54-62
[150] Witlin, Lauren: *Of Note: Mirror-Imaging and Its Dangers* in *SAIS Review of International Affairs*, vol. 28 no. 1, 2008, p. 89
[151] Heuer (1999), p. 70

that others will act the same as we would, given similar circumstances."[152] Other definitions include e.g.: "*--projecting your thought process or values system onto someone else--"*[153] with different variations of wording.[154] The first referral to mirror imaging as a bias in its' current form is Robert Jervis in 1976.[155] Typical case studies concerning mirror imaging however include events from WWII, especially the case of Pearl Harbor.[156]

A problem caused by mirror imaging is its' twofold forms: there is a conscious form of "*thinking like the adversary"* and the unconscious form presented in the definition of the bias.[157] The previous form is a common strategy for analysts at all levels: there are numerous cases of successful application of mirror imaging within military history.[158] The later form of unconscious mirror imaging is the focus of this thesis, as it potentially leads to intelligence failures. While this has been shown especially at strategic levels[159], the same mental model applies to all levels of intelligence. The bias is caused by the availability heuristic presented in chapter 3.2.2. It is also sometimes classified as being a so called social bias, which means that it is primarily caused by interaction between people rather than a heuristic as such.[160] In this thesis the bias is however treated as a bias caused by the availability heuristic, as it described as such within literature and studies within the field of intelligence.[161]

3.4.3 Vividness bias

The *vividness bias* is caused by the availability heuristic. It is also known as the *salience bias*[162]. The definition of vividness bias used in this thesis is: "*Focusing on the most easily recognizable, interesting or shocking features in a set of data, while other possibilities or*

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[152] ACAPS: *Cognitive Biases (*2016), p. 4
[153] Watanabe, Frank: *Fifteen Axioms for Intelligence Analysts (U)* in *Studies in Intelligence*, Vol. 40, No. 5, Semiannual Edition, 1997, p. 46
[154] See e.g.: Bar-Joseph, Uri & Rose McDermott: *Change the Analyst and Not the System: A different Approach to Intelligence Reform* in *Foreign Policy Analysis,* Vol. 4 Issue 2, 2008, p. 129
[155] Jervis, Robert: *Perception and Misperception in International Politics*, Princeton University Press, 1976
[156] Chan, Philip: *Combating the Cognitive Trap of Mirror Imaging: Pitfalls and Possibilities for the Intelligence Officer* in *Pointer, Journal of the Singapore Armed Forces,* Vol. 40, No. 4, 2014, pp. 39-44. Chan presents four cases of mirror imaging in his article - it is worthwhile reading for readers interested in more detail on mirror imaging.
[157] Johnston (2005), pp. 75-76
[158] Heuer (1999), pp. 70-71
[159] Chan (2014), p. 40
[160] ACAPS: *Cognitive Biases (*2016), p. 4.
[161] See e.g.: Heuer (1999) pp. 134-138, Pherson & Pherson (2016), pp. 54-56 or Davies (2014), pp. 123-127
[162] See e.g.: Tiefenbeck, Verena, Lorenz Goette, Kathrin Degen, Vojkan Tasic, Elgar Fleisch, Rafael Lalive & Thorsten Staake: *Overcoming Salience Bias: How Real-Time Feedback Fosters Resource Conservation* in *Management Science*, Vol. 64, No. 3, 2016, pp 1-2 or De Lara, Michel: *Rationally Biased Learning*, 2017 [https://hal.archives-ouvertes.fr/hal-01581982], 11.10.2018, p. 14

potential alternative hypotheses are ignored."[163] While there are many definitions for this bias, the common theme is the human trait on focusing on easily acceptable or shocking inputs, as described by Tversky and Kahneman.[164] This bias has been studies especially in the field of economics, but the similar decision making process under certainty applies to a broader spectrum of human psychology[165] and specifically intelligence analysis.[166]

The availability heuristic is useful in judgement and decision making under uncertainty, which is why this bias is present within the decision process. Tversky and Kahneman however point out, that according to their studies surprising many people fail to learn from experience, causing them to be affected with vividness bias. This is because statistical principles are not learned from everyday experience, due to lack of relevant instances being coded appropriately and examined by the person who experienced it.[167]

3.4.4 Group thinking bias

Group thinking bias (also known as *Groupthink*[168]) was first introduced in 1952.[169] Irvin Janis pioneered initial research on the bias in 1971.[170] The definition used in this thesis is: "*Choosing the option that the majority of the group agrees with or ignoring conflicts within the group due to a desire for consensus."*[171] The bias causes members of a group to feel that belonging to the group becomes of greater importance than expressing individual disagreements. Members therefore avoid going against the flow of the discussion and do not examine thoroughly alternative hypothesis. Typical examples of the research on the effects of this bias have been US strategic level failures (e.g. Pearl Harbor, Bay of Pigs, Vietnam War, Watergate, etc)[172].

Group thinking bias differs from other selected biases, as it does not as such belong to any of the heuristics originally presented by Tversky and Kahneman.[173] Early research by Janis

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[163] ACAPS: *Cognitive Biases (*2016), p. 3
[164] Tversky & Kahneman (1974), pp. 1127-28
[165] Shrum, Trisha: *Behavioral and Experimental Insights on Consumer Decisions and the Environment,* Harvard University, Cambridge, Massachusetts, 2016, pp. 5-10
[166] Heuer (1999), pp. 115-119
[167] Heuer (1999), p. 1130
[168] Janis, Irving L.: *Groupthink* in *Psychology Today*, Vol. 5, No. 6, 1971, pp. 84-90
[169] Whyte Jr, William H.: *Groupthink* in *Fortune*, 1952, pp. 114-117
[170] Janis (1971), pp. 84-90
[171] ACAPS: *Cognitive Biases (*2016), p. 4
[172] See e.g. Janis (1971) or Raven, Bertram H.: *Groupthink, Bay of Pigs, and Watergate Reconsidered* in *Organizational Behavior and Human Decision Processes,* Vol. 73, Is. 2-3, pp. 352-361
[173] Tversky & Kahneman (1974)

however categorizes the effects of the bias based on early research by Tversky and Kahneman.[174] The bias is commonly categorized as a social bias.[175] Indications show that it is more probably present within highly cohesive groups.[176] While the bias as presented by Janis has received some criticism during the approximately fifty years after its' initial publication, it has held as a valid theory as a cause for errors in judgement and decision making.[177]

3.4.5 Anchoring effect

The bias *anchoring effect* is caused by the anchoring and adjustment heuristic described in chapter 3.2.3.[178] The cause of the bias was first presented Muzafer Sherif (et al) in 1958, when they published a study where they described an "*assimilation effect*".[179] The definition of the bias this thesis uses is: "*Relying too heavily on one piece of information, usually the first piece of information found, when making decisions"*[180]. Different definitions have been presented on the bias after the initial publications. While they tend to agree on the effect of the bias, there are many contradicting theories on the cause behind the bias.[181]

Heuers describes the effect within the intelligence analysis process as a mental shortcut, which is hard to overcome. He presents that there is much evidence on analysts being unable to revise their initial judgment (anchoring point) with new inputs available to the analyst. He also offers anchoring effect as a partial cause for overconfident estimations made by analysts.[182] Research in the bias has shown that a person with expertise and experience

[174] Janis (1971), p. 89. It is to be noted, that Tversky & Kahneman made their most famous publication in 1972 (revised in 1974), while Janis published his initial research in 1971. Elements and referrals to Tversky's and Kahneman's initial publications (which would later evolve into heuristics) are however strongly present within Janis' initial research.
[175] See e.g. Janis (1971), Aldag, Ramon J. & Sally R. Fuller: *Beyond fiasco: A reappraisal of the groupthink phenomenon and a new model of group decision processes* in *Psychological Bulletin,* Vol. 113, No. 3, 1993, pp. 533-552 or Baron, Robert S.: *So Right It's Wrong: Groupthink and the Ubiquitous Nature of Polarized Group Decision Making* in *Advances in Experimental Social Psychology,* Vol 37., 2005, pp. 219-253
[176] Keller, Robert T.: *Predictors of the Performance of Project Groups in R & D Organizations* in *The Academy of Management Journal,* Vol. 29, No. 4, 1986, pp. 715-726. Also see Park, Won-Woo: *A Review of Research on Groupthink* in *Journal of Behavioral Decision Making,* Vol. 3, 1990, pp. 229-245
[177] Packer, Dominic J.: *Avoiding Groupthink: Whereas Weakly Identified Members Remain Silent, Strongly Identified Members Dissent About Collective Problems* in *Psychology Science,* Vol. 20, No. 5, 2009, pp. 546-548
[178] Tversky & Kahneman (1974), pp. 1128-1130
[179] Sherif, Muzafer, Daniel Taub & Carl I. Hovland: *Assimilation and contrast effects of anchoring stimuli on judgments* in *Journal of Experimental Psychology,* Vol. 55, No. 2, 1958, pp. 150-155
[180] ACAPS: *Cognitive Biases (*2016) , p. 2
[181] Furnham, Adrian & Hua Chu Boo: *A literature review of the anchoring effect* in *Journal of Behavioral and Experimental Economics,* Vol. 40, No. 1, 2011, pp. 35-42
[182] Heuer (2009), pp. 150-152

within a specific field of expertise make them susceptible to the bias[183], which further justifies its' choice for further research within this study.

3.5 Summary

Cognitive psychology and the *Dual process theory* allow us to understand, how a human mind produces intelligence thought and how the mind is realized to the brain. The heuristics involved in the process (predominantly *System 1* thinking) cause cognitive biases, which lead to errors when making judgments under uncertainty. This forms the framework of this research.

The cognitive biases presented in subchapter 3.2 have been tested in primarily laboratory environments with tests designed to show to workings of the relative heuristic. Empirical research outside laboratories continues, as research moves forward. The relevant five biases to the framework of this thesis were selected based on the literature presented in subchapter 3.3, and presented in more detail in subchapter 3.4, answering the first research sub question.

As research on biases advances, mitigating the effects of biases (or debiasing them) has been attempted with e.g. structured analysis techniques (SAT)[184], or the use of graphical tools to aid analysts.[185] Before this can be done, the relevant cognitive biases must however be recognized, so that their effects can possibly be mitigated. This is primarily caused by the different mechanizes which cause biases: due to the different root causes, different approaches must be used to mitigate the effects. This will be further examined in the next chapter.

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[183] Furnham & Boo (2011), p. 39. Also see e.g.: Englich, Birte & Thomas Mussweiler: *Sentencing under uncertainty: Anchoring effects in the courtroom* in *Journal of Applied Social Psychology*, Vol. 31, No. 7, 2001, pp. 1535-1551, Englich, Birte, Thomas Mussweiler & Fritz Strack: *Playing Dice With Criminal Sentences: The Influence of Irrelevant Anchors on Experts' Judicial Decision Making* in *Personality and Social Psychology Bulletin*, Vol 32, 2006, pp. 188-200, and Northcraft, Gregory B. & Margaret A. Neale: *Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions* in *Organizational Behavior and Human Decision Processes*, Vol. 39, 1987, pp. 84-97

[184] See subchapter 3.4.

[185] Cook & Smallman (2008), pp. 745-754

4 INTELLIGENCE ANALYSIS

The first principle is that you must not fool yourself - and you are the easiest person to fool. - Richard Feynman (Nobel Prize in Physics, 1965)[186]

This chapter gives an overview of the focus process of this thesis: intelligence analysis. Firstly intelligence and intelligence analysis are defined. Three relevant variations of the intelligence cycle are presented and relevance examined. Different requirements imposed on intelligence analysis are then presented, after which relevant structured analysis techniques are examined and chosen. The techniques which were used in the case studies of this research are then briefly presented, focusing on the baseline working of the techniques.

The chapter ends with a summary of intelligence analysis and the relevant functions for this study. The point of view focuses on the impact of cognitive psychology on intelligence analysis. The aim of this chapter is to allow the reader to reach a relevant starting point for examining the field studies presented in chapter five and main results presented in chapter six. The basis for answering thesis' research sub question four (*How do selected structured analyzing techniques affect the impact of cognitive biases in two selected cases?)* is presented in this chapter.

4.1 Definition of intelligence and intelligence analysis

The definition of intelligence and intelligence analysis is crucial, as it outlines the phenomenon being studied. Mark Lowenthal begins his book "*Intelligence - From Secrets to Policy"* with the remark: "*What is intelligence? Why is its definition an issue? Virtually every book written on the subject of intelligence begins with the discussion of what "intelligence" means, or at least how the author intends to use the term."*[187] This quote relays the problem of definitions related with the field of study. Lowenthal defines intelligence: "*Intelligence is the process by which specific types of information important to national security are requested, collected, analyzed, and provided to policy makers; the products of that process; the safeguarding of these processes and this information by counterintelligence activities; and the carrying out of operations as requested by lawful authorities."*[188] He continues to divide the definition into three parts: process, product and organization. His definition con-

[186] https://en.wikiquote.org/wiki/Richard_Feynman, 29.6.2018
[187] Lowenthal (2017), p. 1
[188] Ibid, p. 10

cerning intelligence as a process is most relevant: "*Intelligence can be thought of as the means by which certain types of information are required and requested, collected, analyzed, and disseminated, and as the way in which certain types of covert action are conceived and conducted.*"[189]

There are numerous other definitions of intelligence available.[190] The problem concerning the issue is related to the broadness of the definition. When a definition is too broad, it loses its' power to identify and explain. It can be seen that there are two types of definition: one that classifies the phenomena and entities, and one that aims to use it in an explanatory manner as a single type of phenomenon or entity.[191]

This thesis focuses on intelligence within the military context. Carl von Clausewitz defined intelligence as: "*By intelligence we mean every sort of information about the enemy and his country--.*"[192] The FDF defines military intelligence as follows: "*Military intelligence is divided into strategic, operational and tactical intelligence. -- Operational and tactical intelligence mean the process, which gathers, analyzes, and uses the information gathered for assisting operational leadership and planning, upholding situational awareness for the troops, and for conducting operations and battles.*"[193] For the purposes of this thesis, military intelligence is a product with the aim of delivering information about the enemy or other factors affecting the execution of an operation to the commander, and the activity producing this product.

Focusing on intelligence analysis, the FDF lack a precise definition of intelligence analysis.[194] The Finnish "*Field Manual 2 - Intelligence*" describes intelligence analysis as a process, which uses all the information available collectively during the intelligence cycle. The goal is to answer the questions "So what?" and "What next?" at all the phases of the cycle.[195] The Central Intelligence Agency uses the following definition: "*Intelligence analysis is the application of individual and collective cognitive methods to weight data and test*

[189] Lowenthal (2017), p. 11
[190] For discussion concerning definition of intelligence, see Warner, Michael: *Wanted: A Definition of "Intelligence"* [https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol46no3/article02.html] (19.12.2017). The publication uses sources such as Martin T. Bimfort and Sherman Kent from the 1950's.
[191] Bang (2017), p. 12
[192] Clausewitz, Claus von: *On War,* Princeton University Press, Princeton, New Jersey, 2008, p. 117
[193] FDF Field Manual 2 - Military intelligence (restricted) 2015, p. 38. Translated from Finnish by the author.
[194] While there is no precise definition, intelligence analysis within the context of the FDF is presented in the book: Sipilä et al: *Analyysiopas[Analysis guide] (restricted)*, 2017
[195] FDF Field Manual 2 - Military intelligence (restricted) 2015, p.32. Translated from Finnish by the author.

hypothesis within a secret socio-cultural context."[196] Martin Bang evolves the definition within his doctoral dissertation: "*Intelligence analysis is a knowledge product. Intelligence analysis is primarily a cognitive process, an activity which is mainly preformed inside an analyst's head. It is also a cognitive action conducted in a given and specific social context. This context influences how an assessment is conducted and, subsequently, the outcome."*[197] As the previous examples show, more focus on intelligence analysis is being shifted to the cognitive actions of the analyst during the process, which supports the framework of this theory.[198]

4.2 The intelligence process

The intelligence process is most commonly described with the intelligence cycle. There are numerous different variations of the intelligence cycle[199]. The different variations share four phases: planning, collection, processing/analysis, and dissemination.[200] While the model presents the process as a cycle, as the name indicates, the process is in reality much more complex and nested.[201] Three variations of the intelligence cycle are presented in the figures five to seven. The variations were selected due to relevance to this study.[202]

[196] Hayes, Joseph: *Analytic Culture in the U.S. Intelligence Community*, History Staff, Center for the Study of Intelligence, Central Intelligence Agency, 2007
[197] Bang (2017), p. 2
[198] Krizan, Lisa: *Intelligence Essentials for Everyone,* Joint Military Intelligence College, Washington, DC, 1999, pp. 1-11
[199] Bruce & George (eds) (2014), p. 4. Also see: Clark (2010), p. 10. Within the Finnish context, the traditional intelligence cycle is presented in: Sipilä et al (2017), p. 3.
[200] Bang (2017), p. 15
[201] Ibid, p. 16. Also see Hulnick, Arthur S.: *What's wrong with the Intelligence Cycle* in *Intelligence and National Security*, Vol. 21, No. 6, 2006, pp. 959-979
[202] The basis of selecting these three cycles follows the logic of relevance: The cycle presented by FM 2.0 (US) is commonly used by the central sources of this thesis concerning intelligence analysis, as they originate from the USA. The cycle presented by Clark is commonly used by recent research within the field of intelligence analysis, and the cycle used by the FDF is the one used within training of the subjects of this research (analysts within the FDF frame). More versions (a total of eleven) of the intelligence cycle have been gathered into a single table by Lisa-Christina Winter in her doctoral dissertation (Winter (2018), p. 30).

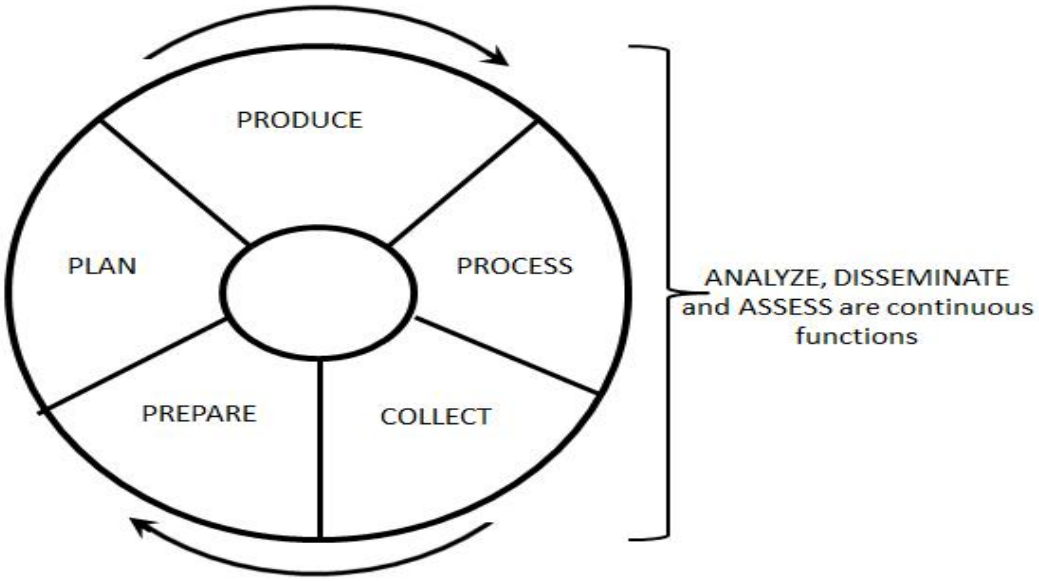


Figure 5. The intelligence cycle as presented by Field Manual 2.0[203]

The cycle presented in figure five is visually the simplest of the three models. It is strongly interlinked with the operations process. The fundamental line of thought is that the operations process provides guidance and focus, which drives the intelligence process. Subsequently the intelligence process provides continuous intelligence input essential to the operations process. This cycle differs from the other presented cycles in the field of analysis: as the picture shows, analysis (also dissemination and assessment) are seen as continuous processes, which are integrated within all the phases of the cycle.[204]

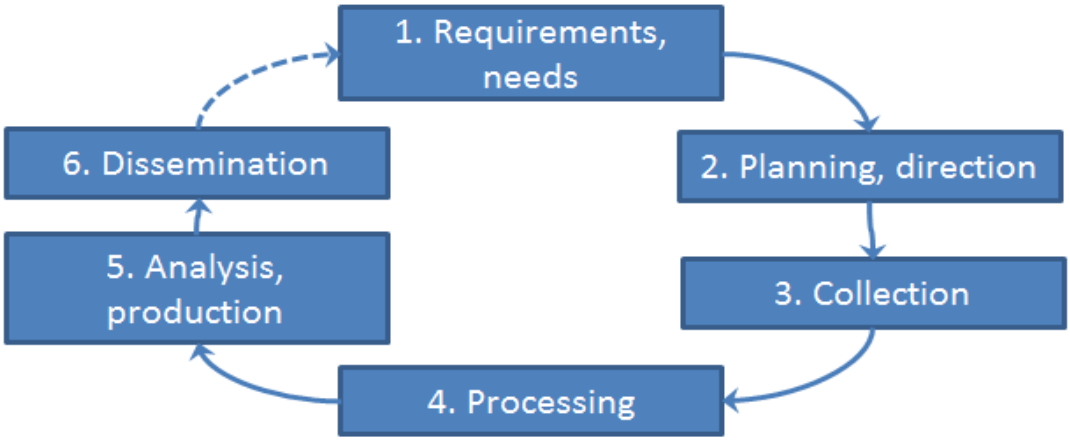


Figure 6. The intelligence cycle as presented by Robert M. Clark[205]

[203] Field Manual 2.0 - Intelligence, 2004, p. 4-2
[204] Ibid, p. 4-2
[205] Clark (2010), p. 10

The cycle presented in figure six is accepted as the traditional intelligence cycle, most commonly present in literature concerning intelligence.[206] It organizes the phases into clear steps, where each phase is finished before moving into the next phase. It presents analysis as a single step, which would allow this study to focus solely on this phase. Reality is however more complex, and in the presentation of the cycle Clark remarks on phase two (planning, direction): *"analysts have to be assigned to do research and write a report"*.[207] This indicates that analysis is also done in this phase to structure the need of intelligence and identify missing pieces of information, which have to be tasked to data collectors.

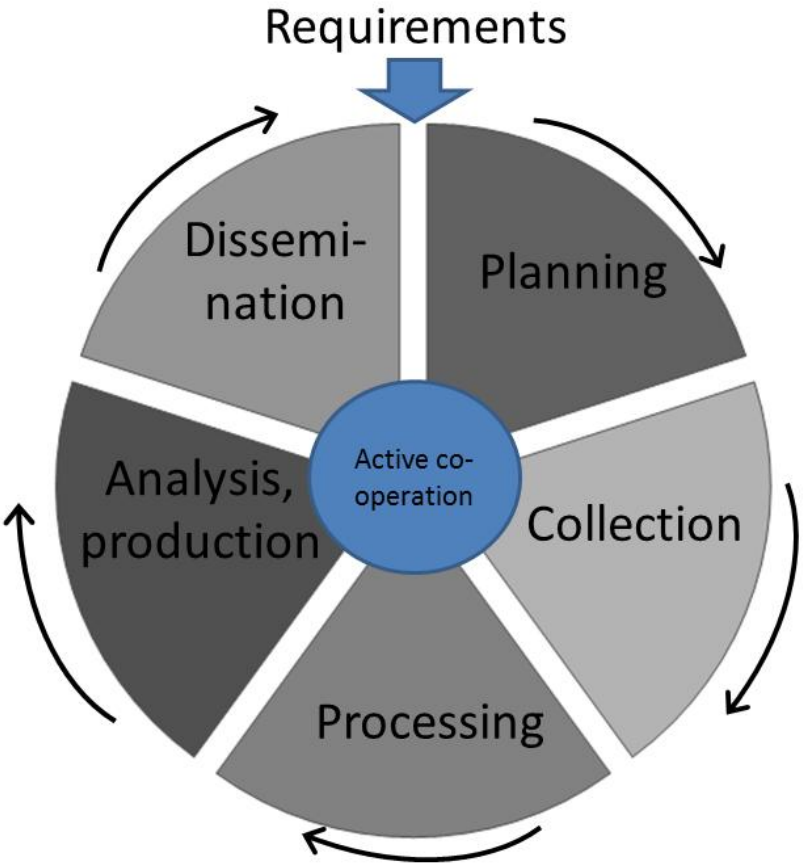


Figure 7. The intelligence cycle as presented by "Analyysiopas"[208]

The cycle presented in figure seven is the cycle used by the FDF. This makes it most relevant for this thesis, as the framework is within this organization. When compared to the traditional intelligence cycle, it can be remarked that the differences are trivial. The emphasis on active co-operation is related to the flexibility of reality, where situations are fluid

[206] Clark (2010), p. 10
[207] Ibid, p. 10
[208] Sipilä et al (2017), p. 3

and change is rapid. The focus of analysis is however in the fourth phase of the cycle in this model.[209]

The analysis and production phase of the intelligence cycle is divided into two steps: structuring and analysis. The collected data is structured to make it more accessible. This may include translating data from different formats (e.g. film or digital symbols) into visible images, or reports from sources (e.g. a remark made by a single soldier or a sighting of a vehicle) being validated and organized into a report format. The newly collected and processed material must then be brought together with relevant historical material to create intelligence in the analysis step.[210]

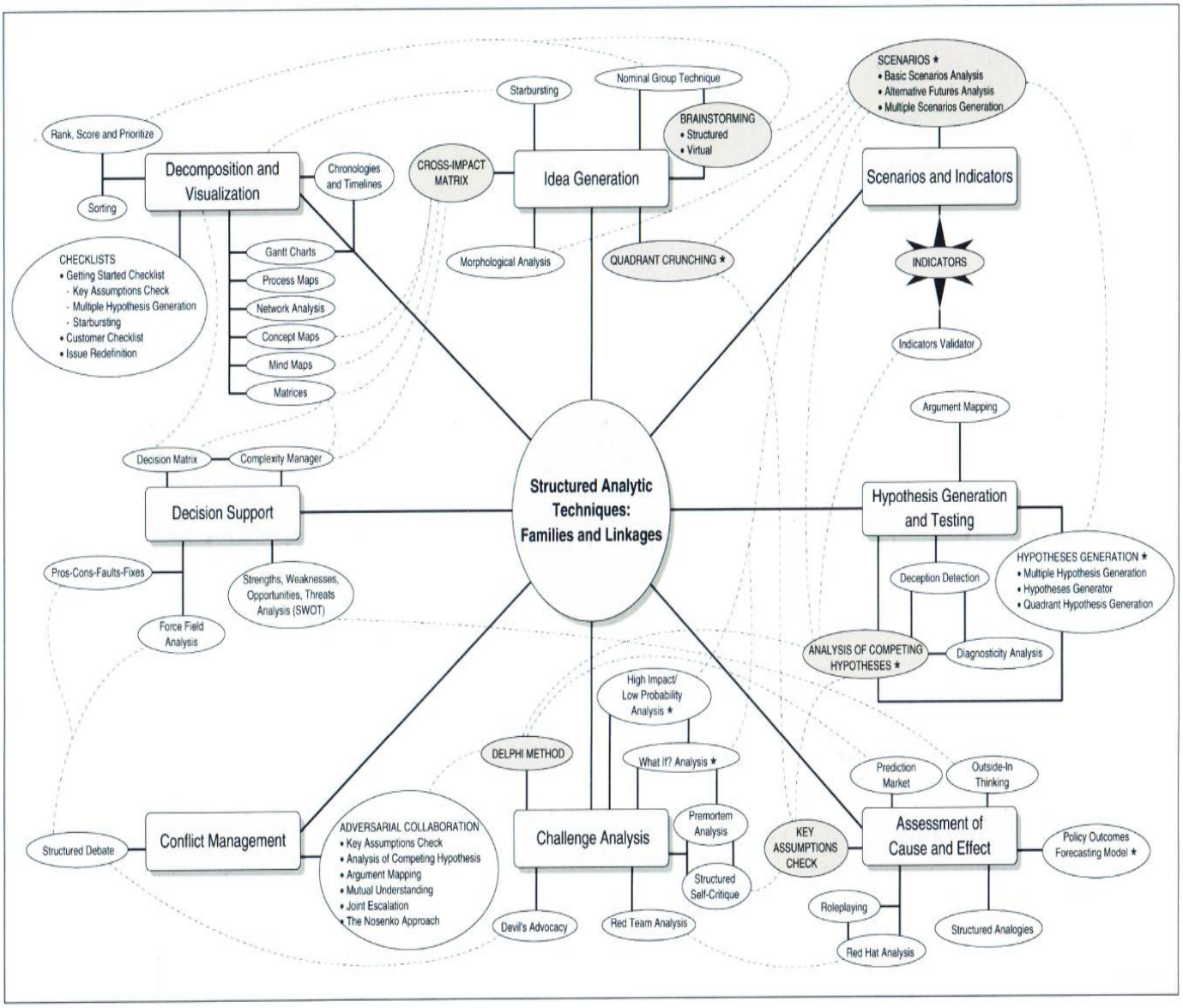
4.3 Requirements and techniques for intelligence analysis

The requirements for intelligence analysis differ greatly when comparing the different levels of intelligence. Long-term research and analysis is used in strategic intelligence: the timeframe is typically days to weeks, up to years. This process includes numerous peer reviews and feedback during the process. Operational intelligence focuses on a more near-term scenario. Current intelligence and analysis is typically used in the tactical level: the timeframe is typically measured in minutes or hours. The matters involved require immediate action. The process is similar to long-term intelligence, as it uses existing models. Time is however cut to the bare minimum, and focus is placed on the essential message. Ideally, the model was created in the research phase of long-term intelligence. Incoming intelligence is simply added to refine the model, and an analysis of changes is extracted and reported quickly.[211]

The focus of intelligence analysis at different levels of intelligence varies. Strategic intelligence focuses on capabilities and plans. In lack of access to actual plans, focus is placed on ability, interests and opportunity windows. They tend to consider many scenarios. Operational intelligence is more focused on supporting a specific operation. Tactical intelligence support focuses on the current situation and especially on indications and warning.[212]

[209] Ibid, p. 4
[210] Clark (2010), p. 11
[211] Ibid, pp. 53-54
[212] Ibid, pp. 58-59

The use of different techniques to improve intelligence analysis has been increased especially after the highly public intelligence failures concerning the terrorist attacks of 9/11 in 2001 and Iraq's weapons of mass destruction in 2002.[213] The field makes use of the theories of cognitive psychology described in chapter three, aiming to make use of the analytic process of "System 2" -thinking. These techniques are commonly described as *Structured analytic techniques*. Their role is to question the intuitive thinking caused by "System 1" -thinking, forcing the analysts to use "System 2" -thinking in their analysis process. Thus use of structured analytic techniques is primarily a debiasing technique.[214]



[213] Heuer & Pherson (2014), p. xvii

[214] Heuer & Pherson (2014), pp. 5-7. Also see Spielmann, Karl: *Strengthening Intelligence Threat Analysis* in *International Journal of Intelligence and Counterintelligence*, Vol. 25, No. 1, 2012, pp. 19-43, and Whitesmith, Martha: *The efficacy of ACH in mitigating serial position effects and confirmation bias in an intelligence analysis scenario* in *Intelligence and National Security*, Vol. 34, No. 2, 2019, pp. 225-242

Figure 8. Structured analytic techniques: Families and Linkages[215]

Heuer and Pherson group different structured analytic techniques into eight different families or domains, presented in figure eight. The division is based on the predominant focus and purpose of each technique. It should be noted that different techniques are a rapidly evolving field - for example between the first and second edition of Heuer and Pherson's book (published in 2011 and 2015 respectively) five new techniques were added.[216] Heuer and Pherson continue by providing a guide on selecting the right technique for a task by defining twelve possible scenarios of the task. The most relevant scenarios for this study are "*Monitor a situation to gain early warning of events or changes that may affect critical interests; avoid surprise?"* which suggests using the techniques of "*Scenarios and Indicators"* or *"Challenge analysis"*, and *"Foresee the future?"* which suggests using the techniques of *"Scenarios and Indicators", "Hypothesis Generation and Testing", "Assessment of Cause and Effect", "Challenge Analysis"* or *"Decision Support"*.[217] The suggested different techniques which were used by the analysts of the cases of this thesis will be examined in the following subchapters.[218]

4.3.1 Analysis of Competing Hypotheses (ACH)

Richard Heuer's primary method for overcoming, or at least minimizing, some of the cognitive limitations that make prescient intelligence analysis difficult to achieve is analysis of competing hypotheses (ACH). The method uses eight steps, grounded in basic insights of from cognitive psychology, decision analysis, and scientific methods. The principal is for analysists to form competing hypotheses (three to seven) and to try to disprove them. This is based on the principal that if an analysis tries to prove a hypothesis to be true, they will look for supporting evidence and easily disregard evidence that does not support their point of view, which avails them to the confirmation bias.[219] The steps originally presented by Heuer outlining the method are:

1. *Identify the possible hypotheses to be considered. Use a group of analysts with different perspectives to brainstorm the possibilities.*

[215] Heuer & Pherson (2014), p. 363
[216] Heuer & Pherson (2014), p. xvii. Also significant revisions were made to four techniques and one technique was divided into two parts. The techniques presented in this source have been peer reviewed and cited by analysts in either governmental intelligence organizations or the private sector.
[217] Ibid, pp. 39-40
[218] The techniques *Decision Support* and *Challenge Analysis* were not used by the analysts within the cases of this thesis. Thus they will not be examined or described in more detail.
[219] Heuer (1999), pp. 95-96. Also see Heuer & Pherson (2014), pp. 181-183

2. *Make a list of significant evidence and arguments for and against each hypothesis.*
3. *Prepare a matrix with hypotheses across the top and evidence down the side. Analyze the "diagnosticity" of the evidence and arguments - that is, identify which items are most helpful in judging the relative likelihood of the hypotheses.*
4. *Refine the matrix. Reconsider the hypotheses and delete evidence and arguments that have no diagnostic value.*
5. *Draw tentative conclusions about the relative likelihood of each hypothesis. Proceed by trying to disprove the hypotheses rather than prove them.*
6. *Analyze how sensitive your conclusion is to a few critical items of evidence. Consider the consequences for the analysis if that evidence were wrong, misleading, or subject to a different interpretation.*
7. *Report conclusions. Discuss the relative likelihood of all the hypotheses, not just the most likely one.*
8. *Identify milestones for future observation that may indicate events are taking a different course than expected.*[220]

The method has been evolved by Heuer and Pherson in 2014, adding a ninth step between the original steps three and four:

4. *Review where analysts differ in their assessments and decide if adjustments are needed in the ratings.*[221]

There are three merits of this method compared to conventional intuitive analysis. Firstly analysis starts with a full set of alternative possibilities, rather than with a most likely alternative which the analyst seeks to confirm. Secondly the method allows analysis to identify and emphasize the items of evidence or assumptions that have the greatest diagnostic value in judging the relative likelihood of the alternative hypotheses. With intuitive analysis, the fact that key evidence may also be consistent with alternative hypotheses is rarely considered explicitly and may be ignored. Thirdly analysis seeks evidence to refute hypotheses, leaving the hypothesis with the least evidence against it as the most probable one rather than the one with the most evidence for it.[222] The method however does require for an open-minded approach of the issue, as an analyst who is already committed to a belief of

[220] Heuer (1999), p. 97
[221] Heuer & Pherson (2014), pp. 185-189
[222] Heuer (1999), p. 108

what the right answer is will easily try to find a way to interpret the relevant information as consistent with that belief.[223]

Heuer notes that using ACH will not guarantee a correct answer. Using it does however guarantee an appropriate process of analysis, using a rational and systematic process rather than an intuitive one. It increases the odds of reaching the correct answer and leaves an audit trail showing the evidence used in the analysis, including how it was interpreted. The method also has the advantage of focusing attention on the items of critical evidence that cause possible uncertainty or which would reduce it if available. This can guide future collection, research, and analysis to resolve the uncertainty and produce a more accurate analysis.[224]

4.3.2 Scenarios and Indicators

Scenarios are plausible and provocative stories about how the future might unfold. They allow decision makers to mentally rehearse these futures, and analysts to identify key underlying forces and factors most likely to influence how the situation develops. Scenarios can thus be used to identify indicators of how the situation is developing. This can help the analysts focus attention to crucial details within the flow of inputs.[225]

Scenarios Analysis is based on identifying and analyzing possible scenarios, with the aim of reducing uncertainties and risk management. By formulating different scenarios, analysts can identify different ways in which a situation may evolve. This type of techniques is most useful when a situation is complex and when outcomes are too uncertain to trust a single prediction. Heuer and Pherson describe three different scenario techniques, out of which *Simple Scenarios* is most useful at the tactical level. This technique is based on primarily listing forces, factors and events that are likely to influence the future. They are then organized in relation to each another, after which at least four scenarios (best case, worst case, mainline and at least one more) are generated. The scenarios are then compared by discriminating drivers. Indicators (observables) are then listed for each scenario, helping tracking

[223] Heuer & Pherson (2014), p. 189
[224] Heuer (1999), p. 109. Also see Gustavi, Tove, Maja Karasalo and Christian Mårtenson: *A tool for generating, structuring, and analyzing multiple hypotheses in intelligence work*, IEEE, 2013, pp. 25-28 and Granåsen, Magdalena and Maja Karasalo: *Methodology and Tool to Facilitate Structured Analysis of Multiple Hypothesis*, IEEE, 2016, pp. 52-54
[225] Heuer & Pherson (2014), pp. 133-135

the evolving situation. The different indicators and scenarios are then observed during the emerging situation.[226]

Indicators are observable phenomena that can be periodically reviewed to track events and warn of unanticipated changes. A list of indicators is established out of observable actions, conditions, facts, or events whose occurrence would argue that a phenomenon is present or highly likely to occur. Indicators are typically used to obtain warning of future development that would have a major impact. The list of indicators should be periodically reviewed and refined, to keep its usability at a high level. Each indicator is examined through five criteria to examine its viability: *Observable and collectible, Valid, Reliable, Stable,* and *Unique*. After forming the list of indicators, analysts review all incoming data to note changes in the indicators. Identifying critical indicators is done to highlight observable early-warning decision points for decision makers.[227]

4.3.3 Assessment of Cause and Effect

Understanding cause and effect of events and actions is the basis for explaining the past and forecasting the future. Reaching such an understanding is however difficult, as the different variables and relationships studied by intelligence analysts can rarely be empirically analyzed as done in academia. This leads to analysts making informed judgments, relying on expertise and reasoning of the analysts. Heuer and Pherson describe three principle strategies analysts use to make these informed judgments: *Situational logic, Comparison with historical situations,* and *Applying theory.* There are five specific techniques suggested by Heuer and Pherson that utilize the three principle strategies. Relevant ones will be briefly examined next, especially emphasizing their use at the tactical level of analysis.[228]

Key Assumptions Check is frequently used by analysts. As analytic judgment is based on a combination of evidence (facts) and assumptions, as there are typically gaps in the evidence. The technique is a systematic effort to explicit the assumptions. The basic idea is to have analysts write down their assumptions independently, after which the assumptions are critically evaluated with a group. Ideally the evaluating group includes outside members.

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[226] Ibid, pp. 133-148
[227] Heuer & Pherson (2014), pp. 133-135, 149-156. For more information concerning indicators, see Pherson, Randolph H.: *Handbook of Analytic Tools and Techniques,* 2nd. ed. Reston, VA: Pherson Associates, LLC, 2008
[228] Heuer & Pherson (2014), pp. 205-208

This allows the assumptions to be identified, thus preventing blind spots within the analysis process.[229]

The *Structured Analogies* technique is based on systematically comparing issues with multiple analogies rather than a single analogy. While the use of the technique as described by Heuer and Pherson is focused on the strategic level of intelligence analysis, the basic idea is viable on lower levels. The core is to identify as many analogies as possible, which are relevant to the current issue. After this, the analogies are examined in more detail, with the purpose of identifying similarities to the current issue. These can then be used to make a forecast on the current issue.[230]

4.4 Summary

The intelligence process is described as a cycle, which contains four to six sequential phases. While there are different models of the cycle (especially how they are illustrated), the concept is fairly similar and universal.[231] The different cycles presented in chapter 4.2 are the most relevant models for this research and thus presented in detail. The cycle has feedback loops built in, which allow for the end product to be peer reviewed before it is disseminated. While analysis is presented as one of the phases within the cycle, in reality it is done in all of the phases. The cycle however allows research on the analysis process to be directed into the relevant phase of the intelligence process, which is why it is essential to understand the cycle (especially the models chosen) and the process it represents within this study.

Using structured analysis techniques is the current normative way of producing intelligence products that are not prone to cognitive biases. They aim in reducing the natural distortions of free-flowing thinking by forming a "*set of principles and procedures for qualitative analysis*", which exposes biased thought processes for correction.[232] The risk of these techniques is that an analyst can apply the wrong technique, or misapply the right technique. They also require time and effort.[233] It is important to note that different techniques are designed to negate the effect of specific biases - a single technique that could debias all biases

[229] Ibid, pp. 207, 209-214
[230] Heuer & Pherson (2014), pp. 207, 215-218. For more information on this technique, it is also advisable to see Neustadt, Richard D. & Ernest R. May: *Unreasoning from Analogies* in *Thinking in Time: The Uses of History for Decision Makers*, Free Press, New York, 1986
[231] Winter (2018), p. 30
[232] Heuer & Pherson (2014), p. 8
[233] Chang & Tetlock (2016), p. 6

is yet to be developed. Structured analysis techniques are being constantly updated within the intelligence community, as research is conducted and experiences of their use are obtained.[234] Similar techniques are also being developed in other fields, which require judgement and decision under uncertainty.[235] These advancements are being used to improve intelligence analysis.[236] The structured analysis techniques presented in chapter 4.3 and its' subchapters were used by the analysts of the cases of this research, and thus presented in enough detail to allow a reader unfamiliar to these techniques to reach an understanding of them. This allows the reader to better evaluate the possible effect the use of these techniques has on debiasing relevant cognitive biases affecting the analysts within this research.

It is important to remember that each of the presented structured analysis techniques is designed to mitigate a specific root cause of error within the analysis process. This leads to some structured analysis techniques being effective against certain cognitive biases, while they may actually cause further risk for an analyst to become susceptible to another cognitive bias. It is thus vital to primarily recognize the cognitive bias that needs to be mitigated, before selecting a certain structured analysis technique to be used. This selection includes evaluating the risk of becoming prone to the effects of another bias. Ideally multiple structured analysis techniques are used within the analysis process - time restraints often do not allow for this.

[234] Chang, Welton, Elissabeth Berdini, David R. Mandel & Philip E. Tetlock: *Restructuring structured analytic techniques in intelligence* in *Intelligence and National Security*, Vol. 33, No. 3, 2018, pp. 337-356. Also see: Odom, William E.: *Intelligence Analysis* in *Intelligence and National Security*, Vol. 23, No. 3, 2008, pp. 316-332, Singh, Jai: *The Lockwood Analytical Method for Prediction within a Probabilistic Framework* in *Journal of Strategic Security*, Vol. 6, No. 3, 2013, pp. 83-99 and *Quick Wins for Busy Analysts*, v.1.3, UK MOD, 2013

[235] See e.g.: Croskerry, Pat: *A Universal Model of Diagnostic Reasoning* in *Academic Medicine*, Vol. 84, No. 8, 2009, pp. 1022-1028 or Croskerry, Pat, Geeta Singhal & Sílvia Mamede: *Cognitive Debiasing 1: Origins of Bias and Theory of Debiasing* in *BMJ Quality & Safety*, Vol. 22, 2013, pp. 58-64

[236] Marrin, Stephen: *Understanding and Improving Intelligence Analysis by Learning From Other Disciplines* in *Intelligence and National Security*, Vol. 32, No. 5, 2017, pp. 539-547

5 FIELD STUDIES

The aim of this chapter is to present the field studies conducted for this thesis. The chapter is divided into four subchapters. The first subchapter describes the test setup briefly. A more detailed description is provided in appendix three (restricted). The second and third subchapters are of a similar structure; respectively they describe case one and two, with further subchapters (third level) presenting findings concerning the five selected cognitive biases. The fourth subchapter is a summary of the findings concerning the field studies, which is further elaborated in chapter six.

The reader should reach an understanding of the findings of this study within this chapter. Appendixes are used to further present data collected from the field studies, including data collection formats used and notes made by the researcher. These allow readers to independently evaluate the results of this research.[237]

5.1 Test Setup

The two cases were conducted within the exercises hosted by the Finnish National Defense University. Both exercises lasted for five days, out of which the three middle days were the primary days of action. Within the exercises, a military unit command was formed out of the participating soldiers. The intelligence section of these unit commands was situated in a private room, where the observations were conducted by the researcher. The exercise setup included simulated communications system, as would be available in actual field operations. The analysis team consisted of three members in case one and six members in case two.

The time frame being handled by the analysts groups within the cases was short-term. In case one the time-frame can be characterized typically as six to twelve hours into the future. At single points, the group focused on estimates of up to 72 hours into the future.[238] During case two, the time frame was typically 12 to 24 hours into the future. Daily the group made estimates of up to 72 hours into the future, with the focus however staying at the shorter

[237] Due to practical reasons, not all data collected by the researcher are included in this report. These include SITREPS documented, audio recordings of the analyst team work space, simulator recordings of the exercises, intelligence reports made by the analyst teams, the transcripts of the final interview etc. All this material is in the possession of the researcher and available upon request, within the limits of the classifications of the material (based on Finnish law).

[238] The level of case one was battalion, where these time frames are very typical.

term.[239] The analysis process focused on opposing force ("red team") future actions, inputs being generated by subordinate units and higher command.

The verbal impact level of different biases within this thesis was modified from scale presenting probability used within the FDF.[240] Table one presents verbal presentations of different levels of probability compared to numeric values, and the verbally descriptive effect of a chosen bias used.

Table 1. Verbal descriptions describing effect used[241]

Verbal descriptions describing effect used in this thesis			
Verbal description of probability	Numeric value	Numeric range	Verbal description of effect
Highly unlikely	5 %	0-15 %	Neglible
Unlikely	20 %	16-35 %	Low
Possible	50 %	36-60 %	Mediocre
Probable	75 %	61-80 %	High
Highly probable	90 %	81-100 %	Very high

Due to security issues, the test setup is described and evaluated in more detail in appendix three (restricted). This appendix is not included in the non-classified version of this thesis.

5.2 Case 1

The summarized observations of case one are presented within table two. The table presents 21 different events during the exercise in which the researcher observed cognitive biases being present.[242] Different biases and their effects are presented within the subchapters of this chapter. As a general trend, it is worthwhile to notice that all three analysts were present in the majority (19/21) of the events observed, contributing into the analysis process. It is also worthwhile to note that all five selected biases were observed during the exercise, but only three of the assumed analysis techniques were observed. Due to the results collected during this case, confirmation bias is analyzed in more detail than the other selected biases.

[239] The level of case two was brigade, where these time frames are typical.
[240] The issue is discussed in chapter 2.3
[241] The columns portraying "*Verbal description of probability*" and "*Numeric value*" are commonly used within the FDF (see e.g.: Sipilä et al (2017)). The columns portraying "*Numeric range*" and "*Verbal description of effect*" were modified by the researcher to use the similar numeric values, thus making the report more easily readable especially for readers familiar to the reports by the intelligence community within the FDF.
[242] A report ("*sitrep")* was written on each of the observed event. They are in the possession of the researcher.

Appendix five includes more detailed data concerning case one. This includes results from the background questionnaire, observations made by the researcher during the case, and results gathered from the final questionnaire. As a general observation, it is worthwhile to note that the analyst team took approximately one day to form their work routines, which lead to only two full days of effective work. The confusion concerning the work routine of the team led to a loss of situational awareness, which was emphasized at the beginning of the second day of the simulation. The different environment caused by the nature of the computer-aided simulator may be a reason for this delay of effective work routines. This is discussed in more detail in chapter six.

The background of the analysts is presented in appendix five. All of the analysts can be characterized as inexperienced. Analyst A had gone through very extensive training concerning intelligence analysis; analyst B had practically no formal training concerning the field. Analyst B however was a bachelor of medicine, which shows academic thinking and can be seen as an asset for an analyst. Analyst C had gone through the basic formal training available to conscripts. The most preferable school subjects varied between the analysts - the focus of the subjects was within natural sciences, with analysts B and C preferring subjects such as chemistry and biology. Analyst A preferred history, geography and English from the possible favorite subjects.

Table 2. Summary of data collected from case one

	Actors present			Biases present					Techniques					
Observation number	A	B	C	Confirmation bias	Mirror imaging	Vividness bias	Group thinking bias	Anchoring effect	ACH	Indicators	Scenarios	Challenge	Decision support	Assessment of Cause and Effect
1	X	X	X	X				X		X	X			
2	X			X						X	X			
3	X	X	X	X			X			X				
4	X	X	X	X	X	X			X					
5	X	X	X	X			X							
6	X							X						
7	X	X	X	X			X			X				
8	X	X	X	X	X				X	X				
9	X	X	X	X					X					
10	X	X	X	X				X		X				
11	X	X	X	X		X			X					
12	X	X	X		X		X							
13	X	X	X		X				X	X				
14	X	X	X	X				X	X					
15	X	X	X	X					X					
16	X	X	X	X					X					
17	X	X	X	X					X					
18	X	X	X	X			X		X					
19	X	X	X	X						X				
20	X	X	X	X	X				X					
21	X	X	X	X		X			X					
SUM	21	19	19	18	5	3	5	4	12	8	2	0	0	0
Percent-age	100 %	90 %	90 %	86 %	24 %	14 %	24 %	19 %	57 %	38 %	10 %	0 %	0 %	0 %

5.2.1 Confirmation bias

Confirmation bias was by far the most common bias detected within case one. It appeared in 18 of the 21 detected cases, or in 86 % of the cases where biases were present. The typical characterization of this bias within this case was within the definition of the bias - the initial hypothesis or conclusion was sought to be strengthened, while information that was in contradiction with this initial conclusion was easily ignored or discarded. This was the technique used to detect the bias by the researcher. It is worth noting that the bias affects all points of the intelligence cycle, where the analyst must make a choice or judgment call. There was no detectable difference within the analysts in this case concerning the frequency or effect of this bias.

A typical example of how this bias affected the analysts can be found in the first SITREP recorded by the researcher in this case. The analysts had evaluated a high probability of an air assault in a certain geographical area. They received inputs concerning red team air assets (attack helicopters) being on the move from their own assets, which lead to the correct conclusion that an air raid was being conducted. They however failed to take into account the logical outcome of the movement indicated by the attack helicopters in this case, as they succumbed into their initial assessment of the location of the air assault. This lead to the analysts correctly analyzing that an air raid was being conducted, but the location of the air raid was analyzed as being as in their original assessment (thus focusing on the first plausible red team course of action), rather than the logical location indicated by the data available.[243]

The effect of the confirmation bias stayed in line with the example presented throughout the first case - while the inputs the analysts received were analyzed, the original red team most likely course of action was always used as a strong comparison, leading to scenarios outside this evaluation being quickly discarded. This trend continued through the whole case, even though events were moving forward, making the initial red team most likely course of action less trustworthy. As a side note, the researcher observed humor being typically used to hide the discernment of other possible scenarios by the analysts.

[243] The material used for this analysis by the researcher include reports made by the analysis team, red team actions (as portrayed by the simulation), audio files recording the discussion conducted by the analysis team and after-action review conducted after the case. Material is in possession of the researcher.

The analysts all recognized the presence of this bias within their own actions and the actions of the group in the final questionnaire, after being informed about the bias. On the scale used within the questionnaire concerning the effect or the bias, they estimated a mediocre (48/100) effect on their own actions, but a slightly stronger mediocre (58/100) effect on the group. An interesting detail is that the most experienced analyst evaluated a high impact on both them self and the group (64 and 63/100 respectively), while the less experienced analysts evaluated a lower (mediocre) impact on themselves than the group (40 /40 personally and 63 / 48 on the group (/100)). This leads to suggest the analysts' ability to recognize the impact of the bias being enhanced by training within the field. The background of the analysts did not have a detectable difference concerning this bias, despite there being large differences between the level of training between the analysts.

The effects of this bias were as expected: the initial hypothesis was being strongly focused on, leaving alternative hypothesis only briefly examined. The quick action of discarding alternative hypothesis led to numerous situations where the analysts were unable to free themselves from their initial thoughts. When the analysts were asked to elaborate how the bias affected themselves or the group, they brought up time pressure especially causing them to focus on the first likely option, discarding other options automatically. This can be characterized as having the analyst being forced to make an initial decision, when new information becomes available, and the analyst has to analyze it. This process is affected by Tversky's and Kahneman's model of availability heuristics, which makes some alternatives seem more likely than others.[244] When the analysis process moves forward, these new inputs are then taken into account within the final product, which in this case was typically an updated red team course of action estimate.[245] This led to systematic errors within these estimates. It is interesting to note that this occurred despite the group trying to use structured analysis techniques (primarily ACH). The use of these techniques was however in an elementary state - this primarily lead to the analysts trying to rather prove their hypothesis to be true, rather than disprove them.

5.2.2 Mirror imaging

Mirror imaging was observed in five of the 21 detected cases, or in 24 % of the cases where biases were present. The typical characterization of this bias within this case was within the

[244] Tversky & Kahneman (1974)
[245] For readers interested in the normative model of activies within the intelligence cycle, see Winter (2018), pp. 45-47

definition of the bias - the actions of the opposing force were being evaluated through the actions of which the analysts themselves would do, rather than through known tactics or methods of the opposing force. The researcher was able to identify this bias being present with comments from the analysts such as: *"What would I do in this situation?"* and *"This makes no sense! I would rather -- (as red team commander)"*. Comments as this were very frequently present when the analysts succumbed to the bias, typically when numerous different inputs were made available to the analysts within a short period of time. There was no detectable difference within the analysts in this case concerning the frequency or effect of this bias.

The analysts all recognized the presence of this bias within their own actions and the actions of the group in the final questionnaire, after being informed about the bias. On the scale used within the questionnaire concerning the effect or the bias, they estimated a low-mediocre (40/100) effect on their own actions, with a mediocre (46/100) effect on the group. There was however a large distribution within this, with the deviation being 27-76. The background of the analysts did not have a detectable difference concerning this bias, despite there being large differences between the levels of training between the analysts.

The effects of this bias were difficult to evaluate precisely. The analysts strongly relied on their training when analyzing the situation and estimating future red team actions, which in itself can fulfil the definition of this bias. The analysts themselves actually saw this bias as an improvement to their work techniques, which leads to believe that the bias in itself was not fully understood by the analysts.[246] This view was enforced by the final interview, when the analysts were asked about this issue.[247] The effects can be categorized in own tactics being enforced into opposing force estimates, which are probably false due to different tactics and basic methods.

5.2.3 Vividness bias

Vividness bias was observed in three of the 21 detected cases, or in 14 % of the cases where biases were present. In all cases it was detected in conjunction with confirmation bias. The bias was detected with its' typical characterization: the analysts focused on the most easily

[246] This suggests that the analysts were unable to understand the twofold forms of the bias. This is examined in more detail in chapter 3.4.2.
[247] The group interview was conducted in Finnish. The recording and transcript are in the possession of the researcher.

recognizable and interesting piece of data from the inputs available, which they assess to be most probable through intuition. Thus, they end up losing the "big picture", and evaluating event possibilities with unrealistic probabilities. This led to less interesting pieces of data being ignored during the analysis process, if the analysts deemed the data to indicate events of low probability. There was no detectable difference within the analysts in this case concerning the frequency or effect of this bias.

None of the analysts recognized the presence of this bias within their own actions or the actions of the group in the final questionnaire, even after being informed about the bias. In the final interview all analysts recognized the phenomenon, and after some further thought one of the analysts identified single events where the bias was present within the group.[248] The experience of the analysts however shows that this bias is difficult to detect personally within one's actions.

The effects of this bias are difficult to evaluate precisely. The analysts relied on their intuition to conduct the primary evaluation of arriving inputs of data, which lead to the effects of the bias. They also relied on intuition[249] to assess the probability of future events, which lead to ignoring inputs concerning red team actions, which did not fit the formed likely courses of action.

5.2.4 Group thinking bias

Group thinking bias was observed in five of the 21 detected cases of biases within case one, or in 24 % of the cases where biases were observed. The bias was observable through the social interaction between analysts, as in a new situation they brought up only conservative ideas on the meaning of the different inputs they accessed. The relative inexperience of all the analysts (even including the most experienced member) most probably had an enforcing effect on the bias.

The social aspect of the setup of the group created a viable environment for the bias, as the leader of the group was much more experienced than the other members. This had the effect of the other members to unconsciously look for a consensus with the experienced member, with the outcome being a textbook example of the bias and its' effects. The mem-

[248] The group interview was conducted in Finnish. The recording and transcript are in the possession of the researcher.
[249] Especially experience from prior tasks (analyst A).

bers (including the experienced member) even noted out the importance of allowing different ideas to be introduced in numerous cases.[250] This however did not end up being observable in practice.

The analysts all stated that they understood the bias and the phenomenon behind it. Only one of the analysts however evaluated it having an effect on their work personally or as a group. The other analysts evaluated the bias not being present within their work during the exercise. Even the analyst who evaluated the bias being present estimated a low effect on their work (personally 23/100 and as a group 28/100). This analyst pointed out the experience of the leading analyst as a reason behind the bias affecting their group, which is in line with earlier research.[251]

The effects of bias were observable - as the single analysts sought to find a consensus rather than sought alternative explanations to the inputs available to them, they ended up making errors. This ultimately caused surprises from the red team, as the analysts did not actually examine alternative explanations. This occurred even in cases, where the alternative explanations expressed by an analyst were actually correct. Had the analysts been able to overcome this bias, they would have properly evaluated alternative explanations, and more probably ended up with correct estimations of the situation.

5.2.5 Anchoring effect

The bias anchoring effect was detected four times during case one. It appeared in 19 % of the cases where biases were present. It must however be noticed, that the phenomenon is fairly similar to confirmation bias. Another researcher may have classified instances now marked as confirmation bias as anchoring effect within the same exercise. The typical characterization of this bias within this case was strictly observed - an event was classified as anchoring effect only if the analysts were clearly anchoring their decisions on the *anchoring point* formed by them. An example of the function of this bias can be found from the first instance a bias was present: the analysts had formed a scenario earlier on, where a cer-

[250] E.g. incidents five and twelve in case one.
[251] For more information concerning prior research on group thinking bias, see e.g. Janis, Irving L.: *Victims of Groupthink: A Psychological Study of Foreign Policy Decisions and Fiascoes*, Houghton Mifflin, Boston, Mass., 1972 or Turner, Marlene E. and Pratkanis, Anthony R.: *Twenty-Five Years of Groupthink Theory and Research: Lessons from the Evaluation of a Theory* in *Organizational Behavior and Human Decision Processes, Vol. 73, Nos. 2/3,* pp. 105-115, 1998
[https://pdfs.semanticscholar.org/b2c3/caa9b3b63b701706429e15191c89d2d87aac.pdf] 29.6.2018

tain type of equipment was used by a protective force. Once inputs concerning the location of this specific piece of equipment were made available to them, they unconsciously went back to the *anchoring point,* and were unable to seriously take into account other explanations to this input. There was no detectable difference within the analysts in this case concerning the frequency of effect of the bias.

The analysts all stated that they understood the definition of this bias and the phenomenon behind it in the final interview.[252] There was however a difference in their evaluation of the presence of this bias and its' effects: analyst A evaluated the bias present in both their personal actions and the actions of the group (with an effect of 62 and 57 /100 respectively), analyst B evaluated the bias not being present in their own actions. Analyst B however evaluated the bias to be present in the group's actions, with a high effect of 63/100. Analyst C evaluated the bias to be present in their own actions (effect 53/100), but not in the group's actions.

The effects of the bias as observed by the researcher were as expected: after anchoring on a piece of information and the scenario formed out of this, contradicting information was either ignored or straight out discarded. This happened even after an initial evaluation of an input being trustworthy and reliable, but after the evaluation of how it fits in relation to the original anchored input, it was discarded and left out of reports submitted to other sections of the headquarters.

5.3 Case 2

The summarized observation of case two are presented within table three. The table presents twelve different events during the exercise which the researcher observed. Different biases and their effects are presented within the subchapters of this chapter. As a general trend, it is worth-while to notice that analysts A-B were present in the majority of the events observed, C-E were present in most of the events, and F was present less frequently. It is also worthwhile to note that all five selected biases were observed during the exercise, but only three of the assumed analysis techniques were observed. These were not the same techniques as in case one. This lead to the questions of the effect of recent training the analysts had received: *Analysis of Competing Hypothesis* (ACH) was the most frequently used structured analysis technique in the first case, but it was not used at all in the second case.

[252] There was some discussion concerning the difference between this bias and confirmation bias during the final interview, which leads to the evaluation of the answers given in the final questionnaire.

This was probably caused by the focus on this structured analysis technique within the training the analysts within the first case had received. The common use of the structured analysis techniques *Indicators* and *Assessment of Cause and Effect* within the second case reflect more to the thinking pattern of the more experiences officers forming the test subjects. As ACH is primarily effective in mitigating the effects of confirmation bias, the difference will be discussed in subchapter 5.3.1.

The lower amount of observed events in case two compared to case one was caused by the time frame the analysts were concentrating on: while in case one the staff was at battalion level, focusing on a shorter time frame and thus using less effort on making broader evaluations of opposing force likely courses of action, the analysts in case two were situated at brigade level, where the time frame tends to be of a longer nature. This difference at operating level also caused the analysts in case two to focus on producing more structured products compared to case one.

Due to the data collected from this case, *confirmation bias* and *group thinking bias* are evaluated more thoroughly than the other biases selected. Especially the causes of group thinking bias being present in this case (compared to case one) is analyzed in more detail.

Appendix six includes more detailed data concerning case two. This includes results from the background questionnaire, observations made by the researcher during the case, and results gathered from the final questionnaire. The analysts were in general much more experienced soldiers than in case one, but their expertise within the field of intelligence did not significantly differ from the analysts in case one. It is however interesting to take note in the fact that almost all of the analysts stated history and geography as one of their most preferable school subject (6/7). This observation is in line with the analysts of the first case of this research.

Table 3. Summary of data collected from case two

	Actors present						Biases present					Techniques					
Observation number	A	B	C	D	E	F	Confirmation bias	Mirror imaging	Vividness bias	Group thinking bias	Anchoring effect	ACH	Indicators	Scenarios	Challenge	Decision support	Assessment of Cause and Effect
1	X	X			X				X	X				X			
2	X	X	X				X			X			X				X
3	X	X		X	X		X				X		X				
4	X	X	X	X	X		X	X		X	X		X	X			X
5			X	X	X		X			X				X			
6	X	X					X			X	X		X	X			
7	X	X	X	X	X	X	X	X		X			X	X			X
8	X	X	X	X	X	X	X			X	X		X	X			
9	X	X	X	X	X		X		X	X			X	X			X
10	X	X	X	X			X		X	X	X		X	X			
11	X					X	X	X	X				X	X			
12	X	X	X	X	X	X	X			X	X		X	X			X
SUM	11	10	8	8	8	4	11	3	4	10	6	0	10	10	0	0	5
Percentage	92 %	83 %	67 %	67 %	67 %	33 %	92 %	25 %	33 %	83 %	50 %	0 %	83 %	83 %	0 %	0 %	42 %

5.3.1 Confirmation bias

As in case one, confirmation bias was the most common bias detected in case two. It appeared in eleven of the twelve detected cases, or in 92 % of the cases where biases were present. The characterization of this bias within this case was within the definition of the bias. There was no detectable difference within the analysts in this case concerning the frequency or effect of this bias.

Five out of the six analysts recognized the presence of this bias within their own actions and actions of the group in the final questionnaire. On the scale used within the questionnaire concerning the effect of the bias, they estimated a high (70/100) effect on both their own and the group's actions. The most experienced analyst however deviated from the oth-

er group in their evaluation of the effect: they estimated a very high effect (100/100) on both themselves and the group's actions. If this evaluation is excluded from the average estimation of the effects of the bias, the group's average estimation declines to high bordering mediocre effect (62/100) concerning both personal and group actions.

The effects of this bias were similar to the effects within case one: the initial hypothesis was focused on, leaving alternative hypothesis to be only briefly examined.[253] The group tended to use structured analytical techniques similar to indicators and scenarios - however, the use in this case was also not actually structured, but rather using elements of the techniques. This led to laziness within the process, allowing confirmation bias to have a large effect on the products and evaluations produced by the team. It is notable that when specifically asked, all members of the group stated that they consciously used both indicators and scenarios as analysis techniques. The lack of the structured analysis technique *Analysis of Competing Hypothesis* lead to the situation, where potentially confirmation bias had a larger effect on the analysis within case two than case one of this research. The personal estimations of the analysists support this, when comparing both the evaluations on personal actions and the groups' actions (48/58 in case one versus 70/70 in case two). The methods of data collection used by the researcher do not allow definite values on the effect of the bias to compare between the cases. The data collected by the personal estimations supported with the verbal remarks in the final questionnaire and remarks made in the ending group interview however suggest, that the analysts in the second case were more affected by confirmation bias than the analysts within the first case.

5.3.2 Mirror imaging

Mirror imaging was observed in three of the twelve detected cases, or in 25 % of the cases where biases were present. The typical characterization of this bias within this case was within the definition of the bias. There was no detectable difference within the analysts in this case concerning the frequency or effect of this bias.

Only half of the analysts (3/6) recognized the presence of this bias within their own actions and the actions of the group in the final questionnaire. Of these analysts, they evaluated the effect of the bias as high (75 and 73/100) effect on their own actions and the group's actions. However, half of the analysts did not recognize this bias being present at all within

[253] The final questionnaire confirms this observation, see appendix six.

the case, even after the bias was presented to them. During the final interview, the analysts all stated that they understood all the biases being studied.[254] Compared to the observations made by the researcher, this leads to the interesting question on why half the analysts did not recognize the bias being present. There was also a large distribution concerning the evaluation of the effects of the bias within case one.

The effects of this bias were difficult to evaluate precisely, as in case one. The tendency of the analysts was to fall back on their basic training, which made the analysts more susceptible to the effects of mirror imaging. The analysts themselves saw falling back to their basic training when filling in gaps of their information concerning events they are evaluating. One analyst even saw the bias as an improvement to their work.[255] The analysts however did not take into account the differences between blue and red team tactics and operational models, which led to errors in the evaluations within the three observed events within this case.

5.3.3 Vividness bias

Vividness bias was detected in four of the twelve detected cases, or in 33 % of the cases where biases were present. As in case one, the bias was detected with its' typical characterization within this case. The similarity of the four cases where this bias was detected was connected to red team actions: the actions the red team were conducting were evaluated to be very dangerous for the blue team. This led to the input leading to this line of thought being focused on with disproportionate focus, leading the analysts to ignore other inputs available at the time. There was no detectable difference within the analysts in this case concerning the frequency or effect of this bias.

Four of the six analysts (67 %) recognized the presence of this bias within their own actions and the actions of the group in the final questionnaire, after being informed about the bias. The analysts who recognized the bias evaluated the effect as high (68/100) within their own actions and mediocre (54/100) within the group's actions. One of the analysts who did not recognize the bias being present participated in three events, where the researcher recognized the bias. The other analyst who did not recognize the bias being present participated

[254] The group interview was conducted in Finnish. The recording and transcript are in the possession of the researcher.
[255] This phenomenon is similar to case one, concerning the twofold forms of mirror imaging described in chapter 3.4.2.

in two similar events. Both were inexperienced within intelligence analysis - one had however taken part in a professional basic analysis course.

The effects of this bias within this case were connected errors within the products produced by the analysis group. The errors can be described as the team producing "text-book models" within their products, rather than the actual evaluations of red team likely future courses of action. Also the tempo of the red team came as a surprise to the analysts - they tended to focus too much on the shocking input, which they evaluated as dangerous to the blue team. The danger (especially within the time span of red team actions) was not apparent within their evaluations.[256]

5.3.4 Group thinking bias

Group thinking bias was observed in ten of the twelve detected cases of biases within case two, or in 83 % of the cases where biases were observed. The bias was observed in a similar manner as in case one. The social structure of the group in case two differed from case one - in this case the members were all well acquainted with each another, differing from the new interaction between members in case one.

The social aspect of the setup of the group would suggest the group to be fairly susceptible to group thinking bias, as one analyst was much more experienced with intelligence analysis compared to the others. This analyst was however only present in four of the twelve detected cases. In one of these cases, group thinking bias was not detected. The bias was however detected in seven other occasions when analyst F was not present. In these cases the difference between the professional experience as analysts was not noticeable.

Within the final questionnaire, only half (3/6, 50 %) of the analysts recognized the bias being present in their own actions. They evaluated the effect to be mediocre (46 / 100) within themselves. Four of the six analysts (67 %) recognized the bias being present in the group's actions.[257] They evaluated the effect to be mediocre (43 / 100) within the group. The questionnaire pointed out expected phenomenon causing the bias: the group tended to "*fall in love*" with an idea, keeping it alive by evaluating incoming inputs to fit into this idea. The

[256] Analysts A, E and F all pointed out the effect of this bias concerning the red team tempo compared to the evaluations produced by the analysis team in the questionnaire conducted at the end of the exercise. Analyst F evaluated that they probably could have mitigated the effect of the bias, had they been aware of it prior to the work done in the exercise.

[257] The three analysts who recognized the bias being present in their own actions all belong to this group.

evaluated low level of effect of the bias is however contrary to the researchers observations. This is in line with the results of case one and earlier research. The effects of the bias were observable as in case one, leading to noticeable errors in the products produced by the team, due to the analytic process being degraded by the search of a common view within the group. While the analysts themselves recognized the function of the bias when asked about it, they still did not agree with the impact of the bias the researcher observed. The observation that the effects of group thinking bias are hard to recognize, when it is impacting a person's judgement and decision making process is in line with earlier research

The difference in the frequency this bias was detected between the two cases is very large. The personal evaluations of the analysts on the impact of the bias are in line with the researcher's observations, when comparing the two cases. The research conducted on this bias by Janis suggest that to counter or mitigate the bias, the group should openly support playing devil's advocate or consciously construct alternative perspectives to the situation. There are seven other suggestions within Janis' article, but these two fit best into the situation of the case being researched.[258] The group failed to fulfil either of these recommendations, which led to the high frequency of appearance of the bias within the second case. The homogeneous structure of the group possibly led to this, or at least made the group and its' members more susceptible to the bias.

The analyst team of case two can be seen as more cohesive than the analysts team researched in case one: the group of case two had been working very closely together for approximately five months upcoming to the case. When this is considered to earlier research, which indicates that highly cohesive groups are more susceptible to group thinking bias than less cohesive groups[259], the cause of the higher frequency of the bias in the second case can probably be explained by this cohesion. This cohesion can be seen to build up during the close co-operation and interaction of the analysts in case two during the previous five months, even though they had not worked in this specific team prior to the exercise. The analysts had also been working within the same organization (Finnish Defense Forces) for approximately fifteen years prior to the exercise, which can be seen as a factor that adds to the cohesion of the group.

5.3.5 Anchoring effect

[258] Janis (1971), pp. 89-90. Janis presents nine different recommendations on how to avoid Group thinking bias (or Groupthink).
[259] This is discussed in further detail in subchapter 3.4.4.

The bias anchoring effect was detected in six of the twelve cases (50 %) biases were detected in case two. As with case one, the actual phenomenon causing the bias is very similar to confirmation bias, making it possible that another researcher may have classified instances now determined as confirmation bias as anchoring effect. In all the instances anchoring effect was detected, confirmation bias was also detected in this case.[260] It is also worth noticing that in the first four instances when anchoring effect was detected within this exercise, the anchoring point was the estimate of red team likely courses of action given to the analysis group at the beginning of the exercise. Part of the analysts had participated in forming the red team courses of action in the weeks prior to the exercise, which strengthens this estimate as the anchoring point of the analysts. This model differs with the first case of this research, as in that case the analysts were only made familiar with the battle plan tested in the exercise at the beginning of the exercise. This probably led to the starting point red team course of action estimate being a lesser anchoring point for the analysts, when comparing to this case. The last instance of anchoring effect observed in case two happened at the end of third day of the exercise, suggesting the high impact of the starting point of the exercise on the analysts.

The final questionnaire showed that four analysts (67 %) evaluated this bias having an impact on their personal actions during the exercise. Five analysts (83 %) evaluated the bias having an impact on the group's actions during the exercise. The analysts who evaluated the bias being present, evaluated a very high impact on their own (83 / 100) and a high impact on the group's (79 / 100) actions. The analyst who did not evaluate this bias being present in their own or the group's actions was the analyst who was least present with the group during the exercise. There was no significant deviation between the estimates of the effect, suggesting that the analysts were able to recognize the major impact it had on their products and analytic work.

The effects of the bias as observed by the researcher and evaluated by the analysts were as expected: the first accepted hypothesis was anchored into the analytic process, with analysts trying to strengthen the hypothesis and search for supporting inputs. Four of the analysts were able to point out the effect the starting point of the exercise had on their analytical work, despite the starting point being an evaluation made by higher command in the exer-

[260] Confirmation bias was however detected in five instances within this case, when anchoring effect was not detected.

cise, which was further elaborated by part of the analysts in the weeks prior to the exercise. The final questionnaire shows how strongly the analysts felt about the effect this bias had on their work, even though their thoughts mostly focus on the starting point given (and further elaborated) to them. This leads to the question on how to reduce this impact, making it possible for analysts to work around the first hypothesis they form or are given in any situation.

5.4 Summary

All five of the selected cognitive biases were detected in the two field studies. The most predominant bias was confirmation bias, which was present in almost all of the instances (86 % and 92 % respectively) of the studies where cognitive biases were detected with the methodology used in this research. The effect confirmation bias had on the analysis was as expected: the analysts sought to confirm the scenario or hypothesis they had first concluded on, leading them to discard inputs that did not fit this line of thought. While the researcher evaluated a high impact on the analytical process caused by this bias, most analysts within the selected cases estimated a mediocre effect on their own and the group's work. The difference with the level of impact between the cases the data suggests is worth noting.

Mirror imaging was present in approximately 25 % of the instances of both selected cases. The effect mirror imaging had on the analysis was as expected: the analysts evaluated the future actions of the red team through the actions the analysts themselves would do in these instances, rather than through the known tactics and methods of operations used by the red team. The effect was evaluated to be mediocre to high by the researcher; the analysts themselves evaluated the effect with a significant deviation (from 27 to 88 / 100, with most evaluations concentrating on the higher end of the scale). While the bias was present in a low amount of detected instances, when it did appear the effect was significant.

Vividness bias was detected in three instances in case one (14 %) and four instances in case two (33 %). The effect vividness bias had on the analysis was in line with earlier research: a shocking piece input and its' conclusions were focused on, causing a similar effect as with confirmation bias. This input was often recognized through intuition, causing the analysts to focus on it with a disproportionate focus. It is notable that none of the analysts in the first case initially evaluated this bias being present within their own or the group's work, despite the researcher recognizing it with the used methodology.

Group thinking bias was detected in five instances in case one (24 %) and ten instances in case two (83 %). The difference between the two selected cases is significant, especially as the researched decided to use the same methodology is both selected cases. The two selected group's differed mostly by general experience within the military context. In experience concerning intelligence analysis, there was no significant difference between the groups. The social structure of the two groups was also fairly similar. There was a difference between the groups concerning how well the different members of the group were acquainted with each another: the group in the first case knew each another for only a manner of months, while the members of the second group had known each another for over a decade. This caused a difference within the working atmosphere between the two groups. This may explain why this bias was so much more common within the second group.

The effect of group thinking bias was more dominant in the second selected case. It can even be categorized as a *laziness* within the group: when a plausible explanation to an input was voiced out by any member of the group, the other members quickly jumped to agree to this explanation. This led to the quick deterring of the quality of the analysis, which was observed by the researcher. A similar phenomenon was also observed in the first selected case, but to a lesser extent. This observation is supported by the results of the final questionnaire.

Anchoring effect was detected in four instances in case one (19 %) and six instances in case two (50 %). The effect was in line with earlier research: once the *anchoring point* was founded, analysts compared all inputs to this line of thought. This lead to the discarding of inputs available to the analysts, which did not fit into the anchored line of thought. In the second selected case, the effect of the given red team likely course of action was predominant through most of the exercise, which lead to the higher frequency of instances observed compared to the first selected case. There was a difference between the analysts' personal evaluation of the presence of this bias and its' effect. Especially in the first selected case, the bias was not seen as having a very large effect. In the second selected case, analysts evaluated a high effect on their personal and group's work. The results are in line with the researcher's observations.

Structured analysis techniques were not as commonly used as predicted by the researcher. In the first selected case, the technique "*Analysis of competing hypothesis"* was mainly used, with *"Indicators"* being used as a supportive technique. In the second selected case,

the techniques "*Indicators*", "*Scenarios*" and "*Assessment of cause and effect*" were used. As a generalization, the techniques were all used in an elementary manner. They were used as a starting point for the analytical work, but they tended to be discarded when the analysts lacked time to use them through the whole process. Lack of traditionally used intelligence software also led to this, as the analysts did not have these tools at their disposal during the selected cases. It can also be argued that the relative inexperience of the analysts led to this situation. If they had been more experienced and had used the software tools designed for intelligence analysis, which force the use of structured analysis techniques, they may have ended up using the techniques in a more profane way.

6 DISCUSSION

The aim of this chapter is to sum up the research. The main results are presented in subchapter 6.1, including discussion concerning the hypothesis presented in chapter 2.2 and answering the research question. Subchapter 6.2 concentrates on methodological limitations and weaknesses detected during the research and suggests topics for further research. Practical implications and recommendations are presented and discussed in subchapter 6.3.

6.1 Main results

The starting hypothesis of this research was:

> *Cognitive biases impact intelligence analysis, causing predictable errors, due to the cognitive psychology of the analysts. Selected (but not all) biases can be debiased by recognizing them and by using structured analysts methods to counter them.*

The purpose of this hypothesis is to allow readers the possibility to evaluate if the researcher has been affected by cognitive biases while conducting the research. The results of this research support that cognitive biases do impact intelligence analysis, causing predictable errors. While this research does not present strong evidence on the cause of the biases (as it was not part of the research problem), nothing related to this study caused doubt on prior research concerning cognitive psychology as the cause of cognitive biases. The selected biases were not successfully debiased by the analysts studied in this research, even though they used structured analysis techniques. The use of structured analysis techniques was however at an elementary level by the analysts, which left doubt on how they would have succeeded in debiasing the biases, if they had been used in a textbook manner. As a conclusion, the initial hypothesis of this research was found to be valid, based on the results of this research.

The main research question of this study was:

> *How do selected cognitive biases appear within intelligence analysis within the tactical level of the land component in two selected cases?*[261]

[261] The cognitive biases were selected with research sub question one (*What cognitive biases are most probably present within two selected cases?)* and answered in chapter three.

All five of the selected biases were detected during the selected cases. *Confirmation bias* was present in almost all of the incidents where biases were detected during the research (86 % and 92 % respectively). It lead to analysts making mistakes, as they sought to confirm their initial beliefs and discarded inputs that did not fit into this view. The observations are in line with other research concerning the bias. The results suggest that analysts within the second case were more affected by confirmation bias than the analysts in the first case. This is possibly caused by the frequent use of the structured analysis technique *Analysis of Competing Hypothesis (ACH)* by the analysts within the first case: this structured analysis technique is specifically designed to mitigate the effects of confirmation bias. The structured analysis technique ACH was not used at all by the analysts in the second case of this research.

Group thinking bias was present in almost all of the incidents (83 %) of case two, where biases were detected. It was however not present very frequently (24 %) in the incidents of the first case. This was the largest deviation of the results found between the two cases. The reason for the difference of the findings is most probably related to the different social structure of the test groups. The second group was a more homogeneous and cohesive group, which makes a group more susceptible to the bias.[262] It is notable that the analysts themselves evaluated a mediocre effect by the bias, while the observations of the researcher suggest a high impact. This supports findings from earlier research, which suggests that when being affected by the bias an individual is unable to fully appreciate the effect it has on them individually or as a group.

Mirror imaging was present in approximately one fourth of the incidents in both cases. The twofold form of the bias was shown by the results of this research. This lead to difficulty in detection of the bias and especially on which form was present during the incident being observed. This also lead to a large deviation within the analysts when they evaluated the effect the bias had on themselves or the group they were functioning in.

Vividness bias was present in approximately one fourth of the incidents in both cases (14 % and 33 % respectively). The effect the bias had on the analysis was in line with earlier research: a shocking new input was focused on (including conclusions formed from it), causing disproportionate attention being put into the input. An interesting observation is that none of the analysts from the first case evaluated the bias being present within their work.

[262] Keller (1986), pp. 715-726

Anchoring effect was present in 19 % and 50 % of the cases respectively. The bias led to analysts comparing to inputs to a formed *anchoring point*, once it was formed. If the new input did not fit the *anchoring point*, it was discarded. The large frequency within the second case was likely caused by a given red team likely course of action, which formed a predominant *anchoring point* for the analyst team through the entire exercise. This anchoring point was enforced by the fact that the analysts had participated in forming this estimate prior to the exercise.

6.2 Methodological limitations and suggestions for future research

The methodological choices made by the researcher allowed a maximum amount of data to be collected from the empirical research in the form of the two cases. The greatest limitation of the methods employed however lie within the role of the researcher: as a single person gathering the data through observation, it lead to the risk of missing crucial inputs due to fatigue or the researcher's focus being on another analyst during an event, which should be noted. There is also the risk of underlining issues affecting the analysts, which this research design is unable to detect. While the problem of a single researcher was taken into account by conducting the an audio recording of the analyst team's working space and by choosing the computer aided exercise as a platform for the observation, it still leaves room for doubt on the completeness of the observations. In possible future research conducted by this design, another observer should be added to the research, and the possibility to document the work with a video recording should be considered.[263]

A second risk concerning the methodological limitations with this research design is the researcher's own cognitive biases, and their possible effect on the research results. This is emphasized by the strong commitment of the researcher to the observation. The reader is given the possibility to make their own judgment on this issue by presenting the initial hypothesis of the researcher within this report, and by reporting the researcher's remarks concerning the hypothesis in this chapter. The notes made by the researcher during the cases are included in the appendixes of this report with the same goal: allowing the reader to evaluate, if the researcher has fallen into the trap of being biased while noting observations. The triangulation of data collection within the empirical part of this research was also designed with the goal of mitigating the possible cognitive biases of the researcher. The data

[263] A possible video recording would have to be anonymized to respect the identity of the analysts studied, before being used.

the researcher collected was so called hard data rather than subjective observations, which was documented with as much detail as possible. The aim of this was to allow later inspection and repetition of the analysis formed from this data.

A third risk concerning the methodological limitations is related to the setup of the exercises used in this thesis. The red team in both the cases was manned by personnel with similar backgrounds to the analysts. In excess to this background, they were also well familiarized with the setup provided by the computer-aided simulation. This leads to the possibility that the actions they conducted as the red team do not represent a realistic model that could occur, but rather using their experience within exercises of similar nature to "win" the two-sided exercise. This could distort the observations made, when comparing the products made by the analyst team to the red team actions. While the researcher did not observe this sort of behavior within the cases of this research, its occurrence cannot be out ruled. This risk could potentially be overcome by using the research design in actual analysis situations, after which the actual events could be used as a comparison after they have unfolded. This would require waiting for the clear picture of events to become available, which could potentially require years of waiting. It would however mitigate the risks on the methodology caused by using a computer-aided exercise.

The small sampling group within the cases is a limitation for the generalization of the results of this research. This was caused by the availability of suitable exercises for the researcher, taking into account the resources that were available for this research. The basic concept and research design however appear to function as planned, making future research using the concept and design an interesting option. It is worthwhile to consider focusing on only *confirmation bias* and *group thinking bias* in future research using this research design, as they were the most frequently present biases in these results. This would also allow the future researcher to divert more focus into these biases and their effects, possibly allowing more insight on the phenomenon and its' effects.

The data collection done on the background of the analysts within this research offered valuable insight to aid analyzing the results, when it comes to data collected on the professional background of the analysts. However, the favorite topics of study within school did not provide meaningful insights that could be used with this research methodology. In possible future studies conducted with similar methodology, this aspect should be further developed, to allow for more meaningful data to be collected concerning the background of the ana-

lysts. Possible areas of further data collection could include grades the analysts have obtained from different school subjects at different levels of education, or how extensively the analysts have studied different subjects during their education. Another possible area for future research could be to examine the analysts' personality types with a test in relation to a similar sort of research. This could provide fruitful insights on how cognitive biases appear and effect different personality types when working as analysts.

Future research using this research design could also be conducted with the modification of focusing more on the analysis products produced by the analysts. This could be done by gathering data with this research design, but also adding the dissemination of the produced product in more detail by the researcher. This could involve the detailed interview of the analyst(s) responsible for producing the product - this would add more depth to the finding concerning the effects of the cognitive biases.[264] The use of the recorded simulation events could easily be used as supporting data for this research view. This would however require much more time put into the research conducted with this addition, causing a need to evaluate the economy of the research method with this addition.

Structured analysis techniques were a minor focus of this research. Future research could further study the mitigating power of specific structured analysis techniques against selected cognitive biases within a similar framework. Especially research on mitigation of *confirmation bias* could potentially be very fruitful, due to the commonness of the bias. This research suggests that *Analysis of Competing Hypothesis* mitigates the effects of confirmation bias, but more thorough research is needed before strong conclusions can be made. Other structured analysis techniques presented in this thesis are also worthy of further research within this field, as they are commonly used to aid the analysis.

The validity of this research is assessed to be high by the researcher, despite limitations presented in previous parts of this subchapter. This is due to the combination of earlier research methodology, which has been previously scientifically validated. This particular research was designed by using these methodologies as a fusion within this field, which allowed leaning back on earlier research concerning validity, but reaching knew information within a previously untapped field and environment of study. Thus this research

[264] Ideally, this dissemination would be done with very great detail, working from word to word. The time the analyst has available for producing the product would obviously have to be factored into the analysis made by the researcher. This suggests focusing on analysis done at a strategic or operational level rather than the tactical level, due to time factors.

offers a scientifically valid methodology to both gather empirical data and assess the data gathered.

6.3 Practical implications and recommendations

The results of this research suggest that cognitive biases, especially *confirmation bias* and *group thinking bias,* can have a negative impact on intelligence analysis. The other three examined biases were also shown to be present within the analysis process. The impact of these observations suggests following the international trend of using structured analysis techniques as a tool within the analysis process. It also strengthens the view that cognitive biases should be taken into account when evaluating the analytical products produced by analysts. Based on internationally available research, the awareness of cognitive biases may help in reducing their effects. As the biases may have a negative impact on intelligence analysis and awareness of the biases may help debiasing them or mitigating the effects, the researcher recommends that awareness of cognitive biases (at least *confirmation bias* and *group thinking bias*) is included in the training scheme of analysts.

In the cases of this research, the researcher observed that analysts failed to properly utilize the structured analytical techniques. This led to the analysis techniques failing in debiasing the analytical process of the analysis, or even mitigating the effects of the biases in a meaningful manner. It also led to the analytical process to be unstructured at times. Based on these observations, the researcher recommends simple structured analytical techniques to be focused on more especially in the early phases of training analysts. Within the context of the Finnish Defense Forces, this means focusing on these techniques especially when training conscripts selected as analysts. The selected structured analytical techniques should especially be focused to mitigate the effects of *confirmation bias,* due to the high frequency of its presence within the research.

The frequency of *group thinking bias* in the second case of this research was notably high. This was most probably caused by the homogeneous background of the analysts, making them susceptible to the bias as a group. This highlights the importance of choice of personnel, when gathering an analysis team. Based on the observations made in the two cases, a more heterogeneous team is preferable as an analysis team. This leads to the recommendation of trying to form analysis teams as diverse units, in order to make them less susceptible

to *group thinking bias*. Within the context of the Finnish Defense Forces, this means using analysts in all analysis teams who are not normally employed by the Finnish Defense Forces, but rather from the reserve. This also allows making use of their civilian profession and analytical abilities learned and developed within that context, which can be employed within the context of the intelligence process. This approach to the choice of personnel also allows broader points of view to the analysis task within the group, which allows for a larger chance to reach a more accurate analysis.

"A general "law of least effort" applies to cognitive as well as physical exertion. The law asserts that if there are several ways of achieving the same goal, people will eventually gravitate to the least demanding course of actions -- Laziness is built deep into our nature."

Daniel Kahneman

SOURCES

1 NON-PUBLISHED SOURCES

1.1 Theses

Ahonen, Lasse: *Tiedusteluprosessi alueellisessa johtoportaassa (ST III) [The Intelligence Process within Regional Headquarters (confidential)]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017

Hannonen, Tero: *Harhauttaminen vaikuttamiskeinona nykyaikaisesa sodankäynnissä (ST IV) [Deception as a Capability in Modern Warfare (restricted)]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017

Jäntti, Jaakko: *Tiedusteluanalyysi: analyysikoulutuksen vaikuttavuuden merkitys (ST IV) [Intelligence Analysis: the Impact on Analysis Training (restricted)] (translated by author)*, SOC 62 thesis, NDU, Helsinki, 2010

Känä, Kai: *Diskurssianalyysi tiedusteluanalyysin lähestymistapana - Venäjän Syyrian operation diskurssiivinen tarkastelu [Discourse analysis as a method of intelligence analysis - a discursive examination of Russia's operation in Syria] (*translated by author), GSOC 58 thesis, NDU, Helsinki, 2017

Murtomäki, Ulla: *Strukturoitujen analyysimenetelmien käytettävyys uhka-arvioiden laadinnassa (ST IV) [The Usability of Structured Analysis Methods in Threat Assessments (restricted)]* (translated by author), GSOC 55 thesis, NDU, Helsinki, 2013

Trontti, Perttu: *Strategisen tason tiedustelun tietotarpeiden täyttäminen pienessä valtiossa (ST IV) [Fulfilling Requirements of Information of Strategic Intelligence within a Small Nation (restricted)]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017

Ylivaara, Annukka: *Tulevaisuuden arviointi strategisessa tiedustelussa" [Future Estimates within Strategic Intelligence]* (translated by author), GSOC 58 thesis, NDU, Helsinki, 2017

1.2 FDF Field Manuals

FDF Field Manual [Kenttäohjesääntö yleinen (ST IV)] (translated by author), Juvenes print, Tampere, 2015

Field Manual 2 - Military intelligence (restricted) [Kenttäohjesääntö 2 - Sotilastiedustelu (ST IV)] (translated by author), Juvenes print, Tampere, 2015

Field Manual 3.1 Army operations [Kenttäohjesääntö 3.1 Maaoperaatiot (ST IV)] (translated by author), Juvenes print, Tampere, 2016

1.3 Other unpublished sources

ACAPS: *Cognitive Biases,* 2016 [https://www.acaps.org/sites/acaps/files/resources/files/acaps_technical_brief_cognitive_biases_march_2016.pdf] 12.1.2018

Army in-service training 2019 (restricted) [Maavoimien täydennyskoulutuskalenteri 2019 (ST IV)] (translated by author). MO9905/25.6.2018

Benson, Buster: *Cognitive bias cheat sheet* [https://betterhumans.coach.me/cognitive-bias-cheat-sheet-55a472476b18] (4.1.2018)

Boolean search [https://www.webopedia.com/TERM/B/Boolean_search.html] (21.12.2017)

Field Manual No. 2-0: Intelligence, Headquarters, Depart of the Army, Washington, DC, 2004

https://en.wikiquote.org/wiki/Richard_Feynman (29.6.2018)

https://puolustusvoimat.fi/en/conscription (4.12.2018)

Intelligence School training scheme 2019 (restricted) [Tiedustelukoulun koulutuskalenteri 2019 (ST IV)] (translated by author). AO11461/15.6.2018

Material collected from selected cases (including questionnaires, audio recordings, researcher's diary, filled observation templates), in possession of researcher

Physiopedia: Visual Analogue Scale [https://www.physiopedia.com/Visual_Analogue_Scale] (28.10.2018)

Publication Forum [https://www.tsv.fi/julkaisufoorumi/haku.php?lang=en] (26.6.2018)

Psychology Wiki: List of biases in judgment and decision making [http://psychology.wikia.com/wiki/List_of_biases_in_judgment_and_decision_making] (29.6.2018)

RECOBIA project website (www.recobia.eu (26.9.2018))

Research permits within the Finnish Defense Forces [Tutkimusluvat puolustusvoimissa] (translated by author). HM751/18.1.2017

Sipilä, Joonas, Tommi Koivula, Olli-Matti Mikkola & Antti Pulkka: *Analyysiopas (STIV)* [Analysis guide (restricted)] (translated by author), NDU, Juvenes Print, Tampere, 2017

2 PUBLISHED SOURCES

2.1 Researches and theses

Bang, Martin: *Military Intelligence Analysis: Institutional Influence*, National Defence University, Series 1: Research Publications No. 14, Juvenes Print, Tampere 2017

Shrum, Trisha: *Behavioral and Experimental Insights on Consumer Decisions and the Environment*, Harvard University, Cambridge, Massachusetts, 2016

Winter, Lisa-Christina: *Mitigation and Prediction of the Confirmation Bias in Intelligence Analysis*, Karl-Franzens-Universität, Graz, 2018

2.2 Literature

Amberland, David: *The Sniper Mind: Eliminate Fear, Deal with Uncertainty, and Make Better Decisions,* St. Martin's Press, 2017

Anderson, John R.: *Cognitive Psychology and Its Implication,*. 8th ed, New York, Worth Publishers, 2015

Artner, Stephen, Richard S. Girven & James B. Bruce: *Assessing the Value of Structured Analytic Techniques in the U.S. Intelligence Community,* RAND Corporation, 2016

Baron, Jonathan: *Thinking and Deciding*, 4th ed., Cambridge, Cambridge University Press, 2008

Beebe, Sarah Miller & Randolph H. Pherson: *Cases in Intelligence Analysis: Structured Analytic Techniques in Action*, 2nd ed., Los Angeles, Sage, 2015

Bruce, James B. & Roger Z. George: *Analyzing Intelligence: National Security Practitioners' Perspectives.* 2nd ed., Washington, DC, Georgetown University Press, 2014

Clark, Robert M. & William L. Mitchell: *Deception: counterdeception and counterintelligence,* CQ press, SAGE Publications, Inc., California, 2018

Clark, Robert M: *Intelligence Analysis: A Target-centric Approach,* 3rd ed. Washington, D.C., CQ Press, 2010

Clark, Robert M: *Intelligence Collection*, Washinton, DC, SAGE Publications, Inc.,CQ Press, 2013

Clausewitz, Claus von: *On War,* Princeton University Press, Princeton, New Jersey, 2008

Cohen, Jacob & Patricia Cohen: *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences,* 2nd ed., Lawrence Erlbaum Associates, Inc., Publishers, New Jersey, 1983

Creswell, John W. & Vicki L. Plano Clark: *Designing and Conducting Mixed Methods Research,* 3rd ed., SAGE Publications, Inc., 2018

DeVellis, Robert F.: *Scale Development - Theory and Applications*, 4th ed., SAGE Publications, Inc, 2017

Dubos, René J.: *Louis Pasteur, Free Lance of Science*, Little, Brown and Company, Boston, 1950

Evans, Jonathan & Keith Frankish: *In Two Minds: Dual Processes and Beyond*, Oxford University Press, Oxford, U.K., 2009

Fingar, Thomas: *Reducing Uncertainty: Intelligence Analysis and National Security,* Stanford, California, Stanford Security Studies, 2011

Fitts, P.M. & M.I. Posner: *Human performance*, Brooks Cole, Belmont, Ca, 1967

George, Roger Z & James B Bruce: *Analyzing Intelligence: National Security Practitioners' Perspectives*, 2nd ed., Washington, DC, Georgetown University Press, 2014

Gigerenzer, Gerd., Todd, P.M. & The ABC Research Group: *Simple Heuristics that Make us Smart*, Oxford University Press, Oxford, U.K., 1999

Heuer, Richards J.: *Psychology of Intelligence Analysis*, Center for the Study of Intelligence, Central Intelligence Agency, 1999

Heuer, Richards J. & Randolph H. Pherson: *Structured Analytic Techniques for Intelligence Analysis*, 2nd ed., Washington, DC, CQ Press, 2014

Hirsjärvi, Sirkka, Pirkko Remes & Paula Sajavaara: *Tutki ja Kirjoita [Research and Write (translated by author)]*, 11th ed., Gummerus Kirjapaino Oy, Jyväskylä, 2005

Hoffman, Robert R. (ed.): *Expertise out of context: Proceedings of the Sixth International Conference on Naturalistic Decision Making*, Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers, 2007

Huttunen, Mika & Jussi Metteri: *Ajatuksia operaatiotaidon ja taktiikan laadullisesta tutkimuksesta* [Thoughts on research in research on operational art and tactics] (translated by author), FNDU, Edita Prima Oy, Helsinki, 2008

Janis, Irving L.: *Victims of Groupthink: A Psychological Study of Foreign Policy Decisions and Fiascoes*, Houghton Mifflin, Boston, Mass., 1972

Jervis, Robert: *Perception and Misperception in International Politics*, Princeton University Press, 1976

Johnston, Rob: *Analytic Culture in the US Intelligence Community: An Ethnographic Study*, Washington, D.C., The Center for the Study of Intelligence, 2005

Kahneman, Daniel: *Thinking Fast and Slow*, Farrar, Straus and Giroux, New York, 2011

Klein, Gary A.: *Sources of power: How people make decisions*, Cambridge, MA, MIT Press, 2001

Koehler, Derek J. & Nigel Harvey: *Blackwell Handbook of Judgment and Decision Making*, Blackwell pub., Oxford, UK, Malden, MA, 2004

Krizan, Lisa: *Intelligence Essentials for Everyone*, Joint Military Intelligence College, Washington, DC, 1999

Lowenthal, Mark M: *Intelligence: From Secrets to Policy*, 7th ed., Stanford, California, Stanford Security Studies, 2017

Lytell, Maria C., Susan G. Straus, Chad C. Serena, Geoffrey Grimm, James L. Doty III, Jennie W. Wenger, Andrea A. Golay, Andrew M. Naber, Clifford A. Grammich & Eric

S. Fowler: *Assessing Competencies and Proficiency of Army Intelligence Analysts Across the Career Life Cycle*, Santa Monica, CA, RAND Corporation, 2017

Marrin, Stephen: *Improving Intelligence Analysis: Bridging the Gap between Scholarship and Practice*. Milton Park, Abingdon, Oxon, England, New York, Routledge, 2011

Metteri, Jussi: *Kvantitatiiviset tutkimusmenetelmät operaatiotaidon ja taktiikan tutkimuksessa* [Quantitative research methods in research on operational art and tactics] (translated by author), NDU, Edita Prima Oy, Helsinki, 2006

Moore, David T: *Critical Thinking and Intelligence Analysis*, Washington, DC, National Defense Intelligence College Press, 2009

Pherson, Katherine Hibbs & Randolph H. Pherson: *Critical Thinking for Strategic Intelligence*, Thousand Oaks, California, CQ Press, 2016

Pherson, Randolph H.: *Handbook of Analytic Tools and Techniques*, 2nd ed., Reston, VA, Pherson Associates, LLC, 2008

Poletiek, Fenna: *Hypothesis-testing behavior*, Psychology Press, 2001

Prunckun, Hank: *Scientific Methods of Inquiry for Intelligence Analysis*, 2nd ed., Lanham, Maryland, Rowman & Littlefield, 2014

Quick Wins for Busy Analysts, v.1.3, UK MOD, 2013

Reason, James: *Human Error*, New York, Cambridge University Press, 1990

Saunders, Mark, Philip Lewis & Adrian Thornhill: *Research Methods for Business Students.* 6th ed., Harlow, Pearson, 2012

Walsh, Patrick F: *Intelligence and Intelligence Analysis*, New York, NY, Routledge, 2011

Yin, Robert K.: *Case Study Research - Design and Methods.* 5th ed., SAGE Publications, Inc, 2014

2.3 Articles

Aldag, Ramon J. & Sally R. Fuller: *Beyond fiasco: A reappraisal of the groupthink phenomenon and a new model of group decision processes* in *Psychological Bulletin*, Vol. 113, No. 3, 1993, pp. 533-552

Alison, Laurence, Emma Barrett & Jonathan Crego: *Criminal investigative decision making: Context and process*, pp. 79-95, in Robert R. Hoffman (ed.): *Expertise out of context: Proceedings of the Sixth International Conference on Naturalistic Decision Making*, Mahwah, NJ, Erlbaum, 2007

Arceneaux, Kevin: *Cognitive Biases and the Strength of Political Arguments* in *American Journal of Political Science*, Vol. 56, No. 2, 2012, pp. 271-285

Bar-Joseph, Uri & Rose McDermott: *Change the Analyst and Not the System: A different Approach to Intelligence Reform* in *Foreign Policy Analysis*, Vol. 4, No. 2, 2008, pp. 26-44

Baron, Robert S.: *So Right It's Wrong: Groupthink and the Ubiquitous Nature of Polarized Group Decision Making* in *Advances in Experimental Social Psychology*, Vol 37., 2005, pp. 219-253

Chan, Philip: *Combating the Cognitive Trap of Mirror Imaging: Pitfalls and Possibilities for the Intelligence Officer* in *Pointer, Journal of the Singapore Armed Forces*, Vol. 40, No. 4, 2014

Chang, Welton & Philip E. Tetlock: *Rethinking the training of intelligence analysts* in *Intelligence and National Security*, 2016, pp. 903-920

Chang, Welton, Elissabeth Berdini, David R. Mandel & Philip E. Tetlock: *Restructuring structured analytic techniques in intelligence* in Intelligence and National Security, Vol. 33, No. 3, 2018, pp. 337-356

Cheikes, Brant A., Mark J. Brown, Paul E. Lehner & Leonard Adelman: *Confirmation Bias in Complex Analyses*, MITRE Center for Integrated Intelligence Systems, Bedford, Massachusetts, 2004

Cook, Maia B. & Harvey S. Smallman: *Human Factors of the Confirmation Bias in Intelligence Analysis: Decision Support From Graphical Evidence Landscapes* in *Human Factors: The Journal of Human Factors and Ergonomics Society*, Vol. 50, No. 5, 2008, pp. 745-754

Croskerry, Pat, Geeta Singhal & Sílvia Mamede: *Cognitive Debiasing 1: Origins of Bias and Theory of Debiasing* in *BMJ Quality & Safety*, Vol. 22, 2013, pp. 58-64

Croskerry, Pat: *A Universal Model of Diagnostic Reasoning* in *Academic Medicine*, Vol. 84, No. 8, 2009, pp. 1022-1028

Davies, Jack: *Why Bad Things Happen to Good Analysts*, pp. 121-134, in Bruce, James B. & Roger Z. George (eds.): *Analyzing Intelligence: National Security Practitioners' Perspectives*, 2nd ed, Washington, DC, Georgetown University Press, 2014

De Lara, Michel: *Rationally Biased Learning*, 2017 [https://hal.archives-ouvertes.fr/hal-01581982], 11.10.2018

Englich, Birte & Thomas Mussweiler: *Sentencing under uncertainty: Anchoring effects in the courtroom* in *Journal of Applied Social Psychology*, Vol. 31, No. 7, 2001, pp. 1535-1551

Englich, Birte, Thomas Mussweiler & Fritz Strack: *Playing Dice With Criminal Sentences: The Influence of Irrelevant Anchors on Experts' Judicial Decision Making* in *Personality and Social Psychology Bulletin*, Vol 32, 2006, pp. 188-200

Fiedler, Klaus: *On the testability of the availability heuristic*, pp. 109-119, in Scholz, Roland W. (ed.): *Decision Making Under Uncertainty*, North-Holland, Amsterdam, 1983

Fiedler, Klaus & Momme von Sydow: *Heuristics and biases: Beyond Tversky and Kahneman's (1974) judgment under uncertainty*, pp. 146-161, in Eysenck, Michael W. & David Groome: *Revisiting the Classical Studies*, SAGE Publications, Inc., 2015

Flick, Uwe: *Triangulation*, pp. 444-461, in Denzin, Norman K. & Yvonna S. Lincoln (eds.): *The SAGE Handbook of Qualitative Research,* 5th edition, SAGE Publications, Inc., 2018

Furnham, Adrian & Hua Chu Boo: *A literature review of the anchoring effect* in *Journal of Behavioral and Experimental Economics*, Vol. 40, No. 1, 2011, pp. 35-42

Gigerenzer, Gerd: *Fast and Frugal Heuristics: The Tools of Bounded Rationality*, pp. 62-88, in Koehler, Derek J. & Nigel Harvey (eds.): *Blackwell Handbook of Judgment and Decision Making*, Blackwell pub., Oxford, UK, Malden, MA, 2004

Gigerenzer, Gerd: *How to Make Cognitive Illusions Disappear: Beyond "Heuristics and Biases"* in *European Review of Social Psychology*, Vol. 2, 1991, pp. 83-115

Haefeli, Mathias & Achim Elfering: *Pain assessment* in *European Spine Journal*, Vol. 15, No. 1, 2006, pp. 17-24

Haselton, Martie. G., Daniel Nettle & Paul W. Andrews: *The evolution of cognitive bias,* pp. 724-746, in David M. Buss (ed.): *The Handbook of Evolutionary Psychology*, Hoboken, NJ, US, John Wiley & Sons Inc., 2005

Haselton, Martie G. & David C. Funder: *The evolution of Accuracy and Bias in Social Judgment*, pp. 14-38, in Schaller, Mark, Jeffry A. Simpson & Douglas T. Kenrick (eds.): *Evolution and Social Psychology*, Psychology Press, 2013

Hayes, John R: *Three problems in teaching skills,* pp. 391-406, in Segal, Judith, Susan F. Chipman & Robert Glaser (eds.): *Thinking and learning (Vol 2)*, Erlbaum, Hillsdale, NJ, 1985

Hilbert, Martin: *Toward a Synthesis of Cognitive Biases: How Noisy Information Processing Can Bias Human Decision Making* in *Psychological Bulletin*, Vol. 138, No. 2, 2012, pp. 211-237

Hulnick, Arthur S.: *What's wrong with the Intelligence Cycle* in *Intelligence and National Security*, Vol. 21, No. 6, 2006, pp. 959-979

Janis, Irving L.: *Groupthink* in *Psychology Today,* Vol. 5, No. 6, 1971, pp. 84-90

Kahneman, Daniel & Amos Tversky: *On the Reality of Cognitive Illusion* in *Psychological Review,* Vol. 103, No. 3, 1996, pp. 582-591

Keller, Robert T.: *Predictors of the Performance of Project Groups in R & D Organizations* in *The Academy of Management Journal,* Vol. 29, No. 4, 1986, pp. 715-726

Keren, Gideon & Karl H. Teigen: *Yet Another Look at the Heuristics and Biases Approach,* pp. 89-109, in Koehler, Derek J. & Nigel Harvey (eds.): *Blackwell Handbook of Judgment and Decision Making*, Blackwell pub., Oxford, UK ; Malden, MA, 2004

Klayman, Joshua: *Varieties of Confirmation Bias* in *Psychology of Learning and Motivation*, Vol. 32, 1995, pp. 385-418

Lopes, Lola L.: *The rhetoric of irrationality* in *Theory and Psychology,* Vol 1, No 1, 1991, pp. 65-82

MacCuish, Donald A.: *Orientation: Key to the OODA Loop - The Culture Factor* in *Journal of Defense Resources Management*, Vol. 3, No. 2, pp 67-75, 2012

Marrin, Stephen: *Understanding and Improving Intelligence Analysis by Learning From Other Disciplines* in *Intelligence and National Security,* Vol. 32, No. 5, 2017, pp. 539-547

Mohanani, Rahul, Iflaah Salman, Burak Turhan, Pilar Rodríguez & Paul Ralph: *Cognitive Biases in Software Engineering: A Systematic Mapping Study,* 2017

Müller-Lyer, FC: *Optische Urteils Täuschungen*, Archiv für Physiologie Suppl, 1889

Neustadt, Richard D. & Ernest R. May: *Unreasoning from Analogies* in *Thinking in Time: The Uses of History for Decision Makers,* Free Press, New York, 1986

Nickerson, Raymond S.: *Confirmation Bias: A Ubiquitous Phenomenon in Many Guises* in *Review of General Psychology*, Vol. 2, No. 2, 1998, pp. 175-220

Northcraft, Gregory B. & Margaret A. Neale: *Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions* in *Organizational Behavior and Human Decision Processes,* Vol. 39, 1987, pp. 84-97

Odom, William E.: *Intelligence Analysis* in *Intelligence and National Security,* Vol. 23, No. 3, 2008, pp. 316-332

Oswald, Margit E. & Stefan Grosjean: *Confirmation bias* in Pohl, Rüdiger F. (ed.): *Cognitive Illusions. A Handbook on Fallacies and Biases in Thinking, Judgement and Memory*, Psychology Press, 2004, pp. 79-96

Packer, Dominic J.: *Avoiding Groupthink: Whereas Weakly Identified Members Remain Silent, Strongly Identified Members Dissent About Collective Problems* in *Psychology Science*, Vol. 20, No. 5, 2009, pp. 546-548

Park, Won-Woo: *A Review of Research on Groupthink* in *Journal of Behavioral Decision Making*, Vol. 3, 1990, pp. 229-245

Puvathingal, Bess J. & Donald A. Hantula: *Revisiting the Psychology of Intelligence Analysis - From Rational Actors to Adaptive Thinkers* in *American Psychologist*, Vol. 67, No. 3, 2012

Rabin, Matthew & Joel L. Schrag: *First Impressions Matter: A Model of Confirmatory Bias* in *The Quarterly Journal of Economics*, Vol. 114, No. 1, 1999, pp. 37-82

Raven, Bertram H.: *Groupthink, Bay of Pigs, and Watergate Reconsidered* in *Organizational Behavior and Human Decision Processes,* Vol. 73, Is. 2-3, 1998, pp. 352-361

Schwandt, Thomas A. & Emily F. Gates: *Case study methodology,* pp. 341-358, in Denzin, Norman K. & Yvonna S. Lincoln (eds.): *The SAGE Handbook of Qualitative Research,* 5th edition, SAGE Publications, Inc., 2018

Sherif, Muzafer, Daniel Taub & Carl I. Hovland: *Assimilation and contrast effects of anchoring stimuli on judgments* in *Journal of Experimental Psychology,* Vol. 55, No. 2, 1958, pp. 150-155

Singh, Jai: *The Lockwood Analytical Method for Prediction within a Probabilistic Framework* in *Journal of Strategic Security,* Vol. 6, No. 3, 2013, pp. 83-99

Spielmann, Karl: *Strengthening Intelligence Threat Analysis* in *International Journal of Intelligence and Counterintelligence,* Vol. 25, No. 1, 2012, pp. 19-43

Tiefenbeck, Verena, Lorenz Goette, Kathrin Degen, Vojkan Tasic, Elgar Fleisch, Rafael Lalive & Thorsten Staake: *Overcoming Salience Bias: How Real-Time Feedback Fosters Resource Conservation* in *Management Science*, Vol. 64, No. 3, 2016, pp. 1458-1476

Turner, Marlene E. & Anthony R. Pratkanis: *Twenty-Five Years of Groupthink Theory and Research: Lessons from the Evaluation of a Theory* in *Organizational Behavior and Human Decision Processes, Vol. 73, Nos. 2/3, 1998, pp. 105-115*

Tversky, Amos & Daniel Kahneman: *Judgment under uncertainty: Heuristics and biases* in *Science*, Vol. 185, No. 4157, 1974, pp. 1124-1131

Wason, Peter C.: *On the failure to eliminate hypotheses in a conceptual task* in *Quarterly Journal of Experimental Psychology,* Vol. 12, No. 3, 1960, pp. 129-140

Watanabe, Frank: *Fifteen Axioms for Intelligence Analysts (U)* in *Studies in Intelligence*, Vol. 40, No. 5, 1997, pp. 45-47

Wewers, Mary Ellen & Nancy K. Love: *A Critical Review of Visual Analogue Scales in the Measurement of Clinical Phenomena* in *Research in Nursing & Health,* Vol. 13, No. 4, 1990, pp. 227-236

Whitesmith, Martha: *The efficacy of ACH in mitigating serial position effects and confirmation bias in an intelligence analysis scenario* in *Intelligence and National Security,* Vol. 34, No. 2, 2019, pp. 225-242

Whyte Jr, William H.: *Groupthink* in *Fortune*, 1952, pp. 114-117

Wilke, Andreas & Rui Mata: *Cognitive Bias*, pp. 531-535, in Ramachandran, Vilayanur S. (ed.): *The Encyclopedia of Human Behavior, vol. 1,* Academic press, 2012

Witlin, Lauren: *Of Note: Mirror-Imaging and Its Dangers* in *SAIS Review of International Affairs*, Vol. 28, No. 1, 2008, pp. 89-90

2.4 Other published sources

Cooper, Jeffery R.: *Curing Analytic Pathologies- Pathways to Improved Intelligence Analysis,* The Center of the Study of Intelligence (CSI), Washington, DC, 2005

Granåsen, Magdalena & Maja Karasalo: *Methodology and Tool to Facilitate Structured Analysis of Multiple Hypothesis,* IEEE, 2016

Gustavi, Tove, Maja Karasalo & Christian Mårtenson: *A tool for generating, structuring, and analyzing multiple hypotheses in intelligence work,* IEEE, 2013

Hayes, Joseph: *Analytic Culture in the U.S. Intelligence Community*, History Staff, Center for the Study of Intelligence, Central Intelligence Agency, 2007

Johnson, Rob: *Analytic Culture in the U.S. Intelligence Community: An Ethnographic Study*, The Center of the Study of Intelligence (CSI), Washington, DC, 2005

Laki Tieteellisten seurain valtuuskunnasta (938/2006) [Finnish scientific community law] (translated by author) [http://www.finlex.fi/fi/laki/alkup/2006/20060938] (14.1.2019)

Lortal, Gaëlle, Philippe Capet & Alain Bertone: *Ontology Building for Cognitive Bias Assessment in Intelligence*, RECOBIA project conference paper, 2014

Nussbaumer, Alexander, Katrien Verbert, Eva-C. Hillemann, Michael A. Bedek & Dietrich Albert: *A Framework for Cognitive Bias Detection and Feedback in a Visual Analytics Environment*, IEEE, 2016

Report of the Select Committee on Intelligence on the U.S. Intelligence Community's Prewar Intelligence Assessments on Iraq together with Additional Views, 2004 [https://www.intelligence.senate.gov/sites/default/files/publications/108301.pdf], 26.7.2018

TENK: *Humanistisen, yhteiskuntatieteellisen ja käyttäytymistieteellisen tutkimuksen eettiset periaatteet ja ehdotus eettisen ennakkoarvioinnin järjestämiseksi* [Ethical principles of research in the humanities and social and behavioural sciences and proposals for ethical review] (http://www.tenk.fi/sites/tenk.fi/files/eettisetperiaatteet.pdf) (20.1.2018)

TENK: *Responsible conduct of research and procedures for handling allegations of misconduct in Finland - Guidelines of the Finnish Advisory Board on Research Integrity 2012 (*http://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf) (20.1.2018)

Treiblmaier, Horst & Peter Filzmoser: *Benefits from Using Continuous Rating Scales in Online Survey Research*, conference presentation from *Thirty Second International Conference on Information Systems*, Shanghai 2011.

Wall, Emily, Leslie M. Blaha, Lyndsey Franklin & Alex Endert: *Warning, Bias May Occur: A proposed Approach to Detecting Cognitive Bias in Interactive Visual Analytics*, IEEE, 2017

Warner, Michael: *Wanted: A Definition of "Intelligence"* [https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol46no3/article02.html] (19.12.2017), 2002

Wheaton, Kristan J.: *Reduce Bias In Analysis: Why Should We Care? (Or: The Effects Of Evidence Weighting On Cognitive Bias And Forecasting Accuracy)*, [http://sourcesandmethods.blogspot.fi/2014/03/reduce-bias-in-analysis-why-should-we.html] (4.1.2018), 2014

APPENDIXES

LIST OF APPENDIXES

THESIS OF CAPTAIN KAUNONEN APPENDIX 1

Analysis of sources

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Ahonen, Lasse	Tiedusteluprosessi alueellisessa johtoportaassa (ST III) [The Intelligence Process within Regional Headquarters (confidential)] (translated by author)	GSOC thesis	2017	-	-	Unknown	Yes	Assessed as scientifically valid.	Usability reduced due to classification.
Aldag, Ramon J. & Sally R. Fuller	Beyond fiasco: A reappraisal of the groupthink phenomenon and a new model of group decision processes	Article	1993	Psychological Bulletin	3	422	Yes	Assessed as scientifically valid.	Group thinking bias.
Alison, Laurence, Emma Barrett & Jonathan Crego	Criminal investigative decision making: Context and process	Article	2007	-	-	11	Yes	Assessed as scientifically valid.	Cognitive psychology, judgment under uncertainty
Amberland, David	The Sniper Mind: Eliminate Fear, Deal with Uncertainty, and Make Better Decisions	Fiction	2017	-	-	-	No	-	Used for single quote to begin main chapter, not as actual source.
Anderson, John R	Cognitive Psychology and Its Implication,. 8th ed	Book	2015	-	-	11007	Yes	Assessed as scientifically valid.	Citations concerning all editions.
Arceneaux, Kevin	Cognitive Biases and the Strength of Political Arguments	Article	2012	American Journal of Political Science	3	151	Yes	Assessed as scientifically valid.	Representativeness heuristic.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Artner, Stephen, Richard S. Girven & James B. Bruce	Assessing the Value of Structured Analytic Techniques in the U.S. Intelligence Community	Book	2016	-	-	5	Yes	Assessed as valid.	Intelligence analysis, including SATs. Published by RAND corporation.
Bang, Martin	Military Intelligence Analysis: Institutional Influence	Doctoral dissertation	2017	-	-	0	Yes	Assessed as scientifically valid.	Doctoral dissertation from FNDU.
Bar-Joseph, Uri & Rose McDermott	Change the Analyst and Not the System: A different Approach to Intelligence Reform	Article	2008	Foreign Policy Analysis	1	35	Yes	Assessed as scientifically valid.	Intelligence analysis, Mirror imaging.
Baron, Jonathan	Thinking and Deciding, 4th ed	Book	2008	-	-	3583	Yes	Assessed as scientifically valid.	Citations concerning all editions.
Baron, Robert S	So Right It's Wrong: Groupthink and the Ubiquitous Nature of Polarized Group Decision Making	Article	2005	Advances in Experimental Social Psychology	2	239	Yes	Assessed as scientifically valid.	Group thinking bias.
Beal, Vangie	Boolean search [https://www.webopedia.com/TERM/B/Boolean_search.html]	Web publish	Unknown	-	-	Unknown	No	Not scientificly reliable.	Only used for background information, first hit on google for search on "Boolean search".
Beebe, Sarah Miller & Randolph H. Pher-	Cases in Intelligence Analysis: Structured Analytic Techniques in Action, 2nd ed.	Book	2015	-	-	32	Yes	Assessed as valid.	Useable concerning SATs & recent history concerning intelligence analysis.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
son									
Benson, Buster	Cognitive bias cheat sheet [https://betterhumans.coach.me/cognitive-bias-cheat-sheet-55a472476b18]	Web publish	2016	-	-	Unknown	No	Not scientificly reliable.	Only used for background information, source found trough wikipeadia page on cognitive biases (https://en.wikipedia.org/wiki/Cognitive_bias).
Bruce, James B. & Roger Z. George	Analyzing Intelligence: National Security Practitioners' Perspectives. 2nd ed.	Book	2014	-	-	8	Yes	Assessed as valid.	Useable concerning intelligence analysis.
Chan, Philip	Combating the Cognitive Trap of Mirror Imaging: Pitfalls and Possibilities for the Intelligence Officer	Article	2014	Pointer, Journal of the Singapore Armed Forces	-	0	Yes	Assessed as valid.	Mirror imaging. Used as a supportive (secondary) source.
Chang, Welton & Philip E. Tetlock	Rethinking the training of intelligence analysts	Article	2016	Intelligence and National Security	1	12	Yes	Assessed as scientifically valid.	Intelligence analysis, intelligence analyst training.
Chang, Welton, Elissabeth Berdini, David R. Mandel & Philip E. Tetlock	Restructuring structured analytic techniques in intelligence	Article	2018	Intelligence and National Security	1	8	Yes	Assessed as scientifically valid.	Intelligence analysis, especially SATs.
Cheikes, Brant A., Mark J. Brown,	Confirmation Bias in Complex Analyses,	Article	2004	-	-	29	Yes	Assessed as scientifically valid.	Confirmation bias, intelligence analysis, SATs. Published by MITRE Center for Integrated Intelligence Systems.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Paul E. Lehner & Leonard Adelman									
Clark, Robert M	Intelligence Analysis: A Target-centric Approach, 3rd ed.	Book	2010	-	-	437	Yes	Assessed as valid.	Valid and relevant book on intelligence analysis.
Clark, Robert M	Intelligence Collection	Book	2013	.	.	16	Yes	Assessed as valid.	Valid and relevant book on intelligence analysis.
Clark, Robert M. & William L. Mitchell	Deception: counterdeception and counterintelligence	Book	2018	-	-	0	No	Assessed as valid.	Useable concerning the use of cognitive biases to enforce deception.
Clausewitz, Claus von	On War	Book	2008	-	-	8776	No	Classics of warfare.	Number of citations is vague, as there are numerous versions on the classic.
Cohen, Jacob & Patricia Cohen	Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences, 2nd ed.	Book	1983	-	-	184064	Yes	Assessed as scientifically valid.	Research methodology.
Cook, Maia B. & Harvey S. Smallman	Human Factors of the Confirmation Bias in Intelligence Analysis: Decision Support From Graphical Evidence Landscapes	Article	2008	Human Factors	2	81	Yes	Assessed as scientifically valid.	Confirmation bias, intelligence analysis, SATs. Debiasing.
Cooper, Jeffery R.	Curing Analytic Pathologies- Pathways to Improved Intelligence Analysis	Other	2005	-	-	95	Yes	Assessed as scientifically valid.	Intelligence analysis, published by CSI.
Creswell, John W. & Vicki L. Plano Clark	Designing and Conducting Mixed Methods Research, 3rd ed.	Book	2018	-	-	24367	Yes	Assessed as scientifically valid.	Research methodology.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Croskerry, Pat	A Universal Model of Diagnostic Reasoning	Article	2009	Academic Medicine	1	539	Yes	Assessed as scientifically valid.	Cognitive biases, debiasing.
Croskerry, Pat, Geeta Singhal & Sílvia Mamede	Cognitive Debiasing 1: Origins of Bias and Theory of Debiasing	Article	2013	BMJ Quality & Safety	2	221	Yes	Assessed as scientifically valid.	Cognitive biases, debiasing.
Davies, Jack	Why Bad Things Happen to Good Analysts	Article	2014	-	-	40	Yes	Assessed as scientifically valid.	Intelligence analysis, cognitive biases.
De Lara, Michel	Rationally Biased Learning	Article	2017	-	-	0	Yes	Assessed as valid.	Vividness bias. Published by HAL archive, which is open to all authors to deposit scholarly documents. As it has not been peer reviewed, it is used as a supportive source.
DeVellis, Robert F.	Scale Development - Theory and Applications, 4th ed.	Book	2017	-	-	20134	Yes	Assessed as scientifically valid.	Research methodology.
Dubos, René J	Louis Pasteur, Free Lance of Science	Book	1950	-	-	340	No	-	Used for single quote.
Englich, Birte & Thomas Mussweiler	Sentencing under uncertainty: Anchoring effects in the courtroom	Article	2001	Journal of Applied Social Psychology	1	327	Yes	Assessed as scientifically valid.	Anchoring effect.
Englich, Birte, Thomas	Playing Dice With Criminal Sentences: The Influence of Irrelevant Anchors on Experts' Judicial Decision Making	Article	2006	Personality and Social Psychology	2	408	Yes	Assessed as scientifically	Anchoring effect.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Mussweiler & Fritz Strack				Bulletin				valid.	
Fiedler, Klaus	On the testability of the availability heuristic	Article	1983	-	-	20	Yes	Assessed as valid.	Availability heuristic. Used as supportive source, as the information available does not justify assessment on the level of scientific quality.
Fiedler, Klaus & Momme von Sydow	Heuristics and biases: Beyond Tversky and Kahneman's (1974) judgment under uncertainty	Article	2015	-	-	29	Yes	Assessed as valid.	Cognitive biases. Used as supportive source, as the information available does not justify assessment on the level of scientific quality.
Fingar, Thomas	Reducing Uncertainty: Intelligence Analysis and National Security	Book	2011	-	-	95	Yes	Assessed as valid.	Useable concerning intelligence analysis.
Flick, Uwe	Triangulation	Article	2018	-	-	3064	Yes	Assessed as scientifically valid.	Citations include all versions of article. Research methodology. Especially used on parts concerning triangulation.
Furnham, Adrian & Hua Chu Boo	A literature review of the anchoring effect	Article	2011	Journal of Behavioral and Experimental Economics	1	406	Yes	Assessed as scientifically valid.	Anchoring effect.
George, Roger Z & James B Bruce	Analyzing Intelligence: National Security Practitioners' Perspectives, 2nd ed.	Book	2014	-	-	8	Yes	Assessed as valid.	Useable concerning intelligence analysis.
Gigerenzer, Gerd	Fast and Frugal Heuristics: The Tools of Bounded Rationality	Article	2004	-	-	531	Yes	Assessed as scientifically valid.	Heuristics. Gigerenzer is the main critic of Tversky's and Kahnemans theory of heuristics.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Gigerenzer, Gerd	How to Make Cognitive Illusions Disappear: Beyond “Heuristics and Biases"	Article	1991	European Review of Social Psychology	1	1175	Yes	Assessed as scientifically valid.	Heuristics. Gigerenzer is the main critic of Tversky's and Kahnemans theory of heuristics.
Granåsen, Magdalena & Maja Karasalo	Methodology and Tool to Facilitate Structured Analysis of Multiple Hypothesis	Article	2016	-	-	0	Yes	Assessed as scientifically valid.	Intelligence analysis, ACH. Published by IEEE.
Gustavi, Tove, Maja Karasalo & Christian Mårtenson	A tool for generating, structuring, and analyzing multiple hypotheses in intelligence work	Article	2013	Intelligence and Security	0	6	Yes	Assessed as scientifically valid.	Intelligence analysis, ACH. Published by IEEE.
Haefeli, Mathias & Achim Elfering	Pain assessment	Article	2006	European Spine Journal	1	191	Yes	Assessed as scientifically valid.	Visual analogue scale.
Hannonen, Tero	Harhauttaminen vaikuttamiskeinona nykyaikaisesa sodankäynnissä (ST IV) [Deception as a Capability in Modern Warfare (restricted)] (translated by author)	GSOC thesis	2017	-	-	Unknown	Yes	Assessed as scientifically valid.	Cognitive biases, deception.
Haselton, Martie G. & David C. Funder	The evolution of Accuracy and Bias in Social Judgment	Article	2013	-	-	106	Yes	Assessed as scientifically valid.	Representativeness heuristic.
Haselton, Martie. G., Daniel Nettle & Paul W.	The evolution of cognitive bias	Article	2005	-	-	336	Yes	Assessed as scientifically valid.	Cognitive bias. The definition was chosen from this source!

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Andrews									
Hayes, John R	Three problems in teaching skills	Article	1985	-	-	198	Yes	Assessed as scientifically valid.	Cognitive psychology.
Hayes, Joseph	Analytic Culture in the U.S. Intelligence Community	Other	2007	-	-	0	Yes	Assessed as valid.	Intelligence analysis, used as supportive source due to lack of scientific validity.
Heuer, Richards J.	Psychology of Intelligence Analysis	Book	1999	-	-	1474	Yes	Assessed as scientifically valid.	One of the founding books concerning the field of intelligence analysis after its' publishing.
Heuer, Richards J. & Randolph H. Pherson	Structured Analytic Techniques for Intelligence Analysis	Book	2014	-	-	321	Yes	Assessed as scientifically valid.	Useable concerning intelligence analysis. Very important source for SATs.
Hilbert, Martin	Toward a Synthesis of Cognitive Biases: How Noisy Information Processing Can Bias Human Decision Making	Article	2012	Psychological Bulletin	3	204	Yes	Assessed as scientifically valid.	Cognitive psychology.
Hirsjärvi, Sirkka, Pirkko Remes & Paula Sajavaara	Tutki ja Kirjoita [Research and Write (translated by author)], 11th ed.	Book	2005	-	-	34271	Yes	Assessed as scientifically valid.	Research methodology.
Hoffman, Robert R. (ed.)	Expertise out of context: Proceedings of the Sixth International Conference on Naturalistic Decision Making	Book	2007	.	-	50	Yes	Assessed as scientifically	Cognitive psychology.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
								valid.	
Hulnick, Arthur S	What's wrong with the Intelligence Cycle	Article	2006	Intelligence and National Security	1	132	Yes	Assessed as scientifically valid.	Intelligence analysis.
Huttunen, Mika & Jussi Metteri	Ajatuksia operaatiotaidon ja taktiikan laadullisesta tutkimuksesta [Thoughts on research in research on operational art and tactics] (translated by author)	Book	2008	-	-	16	Yes	Assessed as scientifically valid.	Research methodology, especially valid for this thesis.
Janis, Irving L	Groupthink	Article	1971	Psychology Today	.	2677	Yes	Assessed as scientifically valid.	Group thinking bias.
Janis, Irving L	Victims of Groupthink: A Psychological Study of Foreign Policy Decisions and Fiascoes	Book	1972	-	-	9126	Yes	Assessed as scientifically valid.	Group thinking bias.
Jervis, Robert	Perception and Misperception in International Politics	Book	1976	-	-	6354	Yes	Assessed as scientifically valid.	Group thinking bias.
Johnson, Rob	Analytic Culture in the U.S. Intelligence Community: An Ethnographic Study	Other	2005	-	-	353	Yes	Assessed as scientifically valid.	Intelligence analysis, cognitive biases.
Johnston, Rob	Analytic Culture in the US Intelligence Community: An Ethnographic Study	Book	2005	-	-	353	Yes	Assessed as scientifically valid.	Useable concerning intelligence analysis.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Jäntti, Jaakko	Tiedusteluanalyysi: analyysikoulutuksen vaikuttavuuden merkitys (ST IV) [Intelligence Analysis: the Impact on Analysis Training (restricted)] (translated by author)	SOC thesis	2010	-	-	Unknown	Yes	Assessed as scientifically valid.	Intelligence analysis, training of analysts.
Kahneman, Daniel	Thinking Fast and Slow	Book	2011	-	-	19868	Yes	Assessed as valid.	Based on Kahneman's (& Tversky's) earlier research and publications.
Kahneman, Daniel & Amos Tversky	On the Reality of Cognitive Illusion	Article	1996	Psychological Review	3	1397	Yes	Assessed as scientifically valid.	Cognitive biases, heuristics.
Keller, Robert T	Predictors of the Performance of Project Groups in R & D Organizations	Article	1986	The Academy of Management Journal	3	569	Yes	Assessed as scientifically valid.	Group thinking bias.
Keren, Gideon & Karl H. Teigen	Yet Another Look at the Heuristics and Biases Approach	Article	2004	-	-	87	Yes	Assessed as scientifically valid.	Heuristics, cognitive biases.
Klayman, Joshua	Varieties of Confirmation Bias	Article	1995	Psychology of Learning and Motivation	2	442	Yes	Assessed as scientifically valid.	Confirmation bias.
Klein, Gary A	Sources of power: How people make decisions	Book	2001	-	-	4507	Yes	Assessed as scientifically valid.	Cognitive psychology, judgment under uncertainty
Koehler, Derek J. & Nigel Harvey	Blackwell Handbook of Judgment and Decision Making	Book	2004	-	-	246	Yes	Assessed as scientifically valid.	Cognitive psychology.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Krizan, Lisa	Intelligence Essentials for Everyone	Book	1999	-	-	196	Yes	Assessed as valid.	Useable concerning intelligence, intelligence analysis and how they have developed in the US.
Känä, Kai	Diskurssianalyysi tiedusteluanalyysin lähestymistapana - Venäjän Syyrian operation diskurssiivinen tarkastelu [Discourse analysis as a method of intelligence analysis - a discursive examination of Russia's operation in Syria] (translated by author)	GSOC thesis	2017	-	-	Unknown	Yes	Assessed as scientifically valid.	Intelligence analysis, SATs, cognitive biases and their effect on intelligence analysis.
Lopes, Lola L.	The rhetoric of irrationality	Article	1991	Theory and Psychology	1	349	Yes	Assessed as scientifically valid.	Heuristics and cognitive biases.
Lortal, Gaëlle, Philippe Capet & Alain Bertone	Ontology Building for Cognitive Bias Assessment in Intelligence	Conference paper	2014	-	-	0	Yes	Assessed as scientifically valid.	Published on Research gate, part of RECOBIA project.
Lowenthal, Mark M	Intelligence: From Secrets to Policy, 7th ed.	Book	2017	-	-	1002	Yes	Assessed as scientifically valid.	Intelligence and intelligence analysis.
Lytell, Maria C., et al	Assessing Competencies and Proficiency of Army Intelligence Analysts Across the Career Life Cycle	Book	2017	-	-	0	Yes	Assessed as valid.	Published by RAND corporation, used as supporting source on what types of requirements there are on analysts.
MacCuish, Donald A	Orientation: Key to the OODA Loop - The Culture Factor	Article	2012	Journal of Defense Resources Management	0	6	Yes	Assessed as scientifically valid.	OODA-loop.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Marrin, Stephen	Improving Intelligence Analysis: Bridging the Gap between Scholarship and Practice	Book	2011	-	-	69	Yes	Assessed as scientifically valid.	Intelligence analysis, including SATs.
Marrin, Stephen	Understanding and Improving Intelligence Analysis by Learning From Other Disciplines	Article	2017	Intelligence and National Security	1	6	Yes	Assessed as scientifically valid.	Intelligence analysis, its' development and relation to other fields.
Metteri, Jussi	Kvantitatiiviset tutkimusmenetelmät operaatiotaidon ja taktiikan tutkimuksessa [Quantitative research methods in research on operational art and tactics] (translated by author)	Book	2006	-	-	6	Yes	Assessed as scientifically valid.	Research methodology, especially valid for this thesis.
Mohanani, Rahul, Iflaah Salman, Burak Turhan, Pilar Rodríguez & Paul Ralph	Cognitive Biases in Software Engineering: A Systematic Mapping Study	Scientific paper	2017	IEEE transactions	0	1	Yes	Assessed as valid.	Used as a supportive source concerning other research being conducted on cognitive biases.
Moore, David T	Critical Thinking and Intelligence Analysis	Book	2009	-	-	144	Yes	Assessed as scientifically valid.	Intelligence analysis.
Murtomäki, Ulla	Strukturoitujen analyysimenetelmien käytettävyys uhka-arvioiden laadinnassa (ST IV) [The Usability of Structured Analysis Methods in Threat Assessments (restricted)] (translated by author)	GSOC thesis	2013	-	-	Unknown	Yes	Assessed as scientifically valid.	Intelligence analysis, SATs.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Müller-Lyer, FC	Optische Urteils Täuschungen	Article	1889	-	-	54	Yes	Assessed as scientifically valid.	Used as primary source for well-known and cited illusion. The number of citations is suspisiously low, considering the fundamental findings being referred to.
Neustadt, Richard D. & Ernest R. May	Unreasoning from Analogies	Article	1986	-	-	1363	Yes	Assessed as scientifically valid.	Overcoming biases using SATs. Published in book "Thinking in Time".
Nickerson, Raymond S	Confirmation Bias: A Ubiquitous Phenomenon in Many Guises	Article	1998	Review of General Psychology	1	4071	Yes	Assessed as scientifically valid.	Confirmation bias.
Northcraft, Gregory B. & Margaret A. Neale	Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions	Article	1987	Organizational Behavior and Human Decision Processes	2	1051	Yes	Assessed as scientifically valid.	Anchoring effect.
Nussbaumer, Alexander, et al	A Framework for Cognitive Bias Detection and Feedback in a Visual Analytics Environment	Scientific paper	2016	IEEE transactions	-	6	Yes	Assessed as scientifically valid.	Cognitive bias, Research methodology.
Odom, William E.	Intelligence Analysis	Article	2008	Intelligence and National Security	1	37	Yes	Assessed as scientifically valid.	Intelligence analysis, SATs, development of field.
Oswald, Margit E. & Stefan Grosjean	Confirmation Bias	Article	2004	-	-	276	Yes	Assessed as scientifically valid.	Confirmation bias.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Packer, Dominic J.	Avoiding Groupthink: Whereas Weakly Identified Members Remain Silent, Strongly Identified Members Dissent About Collective Problems	Article	2009	Psychology Science	0	112	Yes	Assessed as scientifically valid.	Group thinking bias.
Park, Won-Woo	A Review of Research on Groupthink	Article	1990	Journal of Behavioral Decision Making	2	173	Yes	Assessed as scientifically valid.	Group thinking bias.
Pherson, Katherine Hibbs & Randolph H. Pherson	Critical Thinking for Strategic Intelligence	Book	2016	-	-	30	Yes	Assessed as scientifically valid.	Intelligence analysis. Focuses on strategic level, but is also appliable to tactical and operative levels.
Pherson, Randolph H	Handbook of Analytic Tools and Techniques, 2nd ed.	Book	2008	-	-	0	Yes	Assessed as valid.	Intelligence analysis, especially SATs.
Poletiek, Fenna	Hypothesis-testing behavior	Book	2001	-	-	8	Yes	Assessed as scientifically valid.	Cognitive psychology, judgment under uncertainty
Prunckun, Hank	Scientific Methods of Inquiry for Intelligence Analysis, 2nd ed.	Book	2014	-	-	34	Yes	Assessed as scientifically valid.	Intelligence analysis, including SATs.
Rabin, Matthew & Joel L. Schrag	First Impressions Matter: A Model of Confirmatory Bias	Article	1999	The Quarterly Journal of Economics	3	851	Yes	Assessed as scientifically valid.	Confirmation bias.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Raven, Bertram H.	Groupthink, Bay of Pigs, and Watergate Reconsidered	Article	1998	Organizational Behavior and Human Decision Processes	2	52	Yes	Assessed as scientifically valid.	Group thinking bias.
Reason, James	Human Error	Book	1990	-	-	12326	Yes	Assessed as scientifically valid.	Cognitive psychology.
Saunders, Mark, Philip Lewis & Adrian Thornhill	Research Methods for Business Students. 6th ed.	Book	2012	-	-	22146	Yes	Assessed as scientifically valid.	Research methodology.
Schwandt, Thomas A. & Emily F. Gates	Case study methodology	Article	2018	-	-	0	Yes	Assessed as scientifically valid.	Research methodology. Used as supportive source concerning case study methodology. Published by SAGE Publications.
Sherif, Muzafer, Daniel Taub & Carl I. Hovland	Assimilation and contrast effects of anchoring stimuli on judgments	Article	1958	Journal of Experimental Psychology	3	412	Yes	Assessed as scientifically valid.	Confirmation biases, especially anchoring effect.
Shrum, Trisha	Behavioral and Experimental Insights on Consumer Decisions and the Environment	Doctoral dissertation	2016	-	-	1	Yes	Assessed as scientifically valid.	Doctoral dissertation from Harvard University.
Singh, Jai	The Lockwood Analytical Method for Prediction within a Probabilistic Framework	Article	2013	Journal of Strategic Security	0	1	Yes	Assessed as valid.	Intelligence analysis, SATs, development of field.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Sipilä, Joonas, Tommi Koivula, Olli-Matti Mikkola & Antti Pulkka	Analyysiopas (STIV) [Analysis guide (restricted)] (translated by author)	FDF manual	2017	-	-	Unknown	Yes	Official publication of FNDU by wellknown professionals of the field.	Used as background information concerning analysis within the FDF context.
Spielmann, Karl	Strengthening Intelligence Threat Analysis	Article	2012	International Journal of Intelligence and Counterintelligence	1	2	Yes	Assessed as scientifically valid.	Intelligence analysis, SATs.
Tiefenbeck, Verena, et al	Overcoming Salience Bias: How Real-Time Feedback Fosters Resource Conservation	Article	2016	Management Science	0	0	Yes	Assessed as valid.	Vividness bias. Used as a supportive source concerning the bias.
Treiblmaier, Horst & Peter Filzmoser	Benefits from Using Continuous Rating Scales in Online Survey Research	Conference paper	2011	-	-	8	Yes	Assessed as scientifically valid.	Published on Research gate.
Trontti, Perttu	Strategisen tason tiedustelun tietotarpeiden täyttäminen pienessä valtiossa (ST IV) [Fulfilling Requirements of Information of Strategic Intelligence within a Small Nation (restricted)] (translated by author)	GSOC thesis	2017	-	-	Unknown	Yes	Assessed as scientifically valid.	Intelligence analysis.
Turner, Marlene E. & Anthony R. Pratkanis	Twenty-Five Years of Groupthink Theory and Research: Lessons from the Evaluation of a Theory	Article	1998	Organizational Behavior and Human Decision Processes	2	263	Yes	Assessed as scientifically valid.	Group thinking bias.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Tversky, Amos & Daniel Kahneman	Judgment under uncertainty: Heuristics and biases	Article	1974	Science	3	47965	Yes	Assessed as scientifically valid.	Basic theory of cognitive biases.
Wall, Emily, Leslie M. Blaha, Lyndsey Franklin & Alex Endert	Warning, Bias May Occur: A proposed Approach to Detecting Cognitive Bias in Interactive Visual Analytics	Scientific paper	2017	IEEE transactions	0	18	Yes	Assessed as scientifically valid.	Cognitive biases.
Walsh, Patrick F	Intelligence and Intelligence Analysis	Book	2011	-	-	84	Yes	Assessed as scientifically valid.	Intelligence analysis.
Warner, Michael	Wanted: A Definition of "Intelligence"	Other	2002	-	-	209	Yes	Assessed as scientifically valid.	Intelligence, intelligence analysis. Used to define intelligence and intelligence analysis.
Wason, Peter C.	On the failure to eliminate hypotheses in a conceptual task	Article	1960	Quarterly Journal of Experimental Psychology	1	2197	Yes	Assessed as scientifically valid.	Confirmation bias.
Watanabe, Frank	Fifteen Axioms for Intelligence Analysts	Article	1997	Studies in Intelligence	0	22	No	Assessed as valid.	Used as a supportive source concerning biases affecting intelligence analysis from a perspective of the professional community.
Wewers, Mary Ellen &	A Critical Review of Visual Analogue Scales in the Measurement of Clinical Phenomena	Article	1990	Research in Nursing & Health	2	2342	Yes	Assessed as scientifically	Research methodology, Visual Analogue Scale.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
Nancy K. Love								valid.	
Wheaton, Kristan J.	Reduce Bias In Analysis: Why Should We Care? (Or: The Effects Of Evidence Weighting On Cognitive Bias And Forecasting Accuracy)	Webpage	2014	-	-	-	Yes	Assessed as valid.	Used as secondary source to present ongoing public debate on heuristics, cognitive biases and debiasing.
Whitesmith, Martha	The efficacy of ACH in mitigating serial position effects and confirmation bias in an intelligence analysis scenario	Article	2019	Intelligence and National Security	1	0	Yes	Assessed as scientifically valid.	Confirmation bias, intelligence analysis, SATs.
Wilke, Andreas & Rui Mata	Cognitive Bias	Article	2012	-	-	0	Yes	Assessed as scientifically valid.	Cognitive biases. Published in The Encyclopedia of Human Behavior, vol. 1, Academic press, which validates the souce.
Winter, Lisa-Christina	Mitigation and Prediction of the Confirmation Bias in Intelligence Analysis	Doctoral dissertation	2018	-	-	0	Yes	Assessed as scientifically valid.	Doctoral dissertation from Karl-Franzens-Universität Graz
Witlin, Lauren	Of Note: Mirror-Imaging and Its Dangers	Article	2008	SAIS Review of International Affairs	1	15	Yes	Assessed as scientifically valid.	Mirror imaging.
Yin, Robert K.	Case Study Research - Design and Methods. 5th ed.	Book	2014	-	-	164389	Yes	Assessed as scientifically valid.	Research methodology, especially valid for this thesis (case study planning and methodology).
Ylivaara, Annukka	Tulevaisuuden arviointi strategisessa tiedustelussa [Future Estimates within Strategic Intelligence] (translated by author)	GSOC thesis	2017	-	-	Unknown	Yes	Assessed as scientifically valid.	Intelligence analysis.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
	ACAPS: Cognitive Biases	Web publish	2016	-	-	Unknown	Yes	Assessed as reliable.	Cognitive biases. ACAPS is a non-profit organization; this source was chosen as a starting point for designing data collection protocol. The biases chosen were then furthur studied with scientifically reliable sources.
	Army in-service training 2019 (restricted) [Maavoimien täydennyskoulutuskalenteri 2019 (ST IV)]	FDF order	2018	-	-	-	No	Official document (order) of FDF.	Used to describe training system for professional analysts within FDF.
	FDF Field Manual [Kenttäohjesääntö yleinen (ST IV)] (translated by author)	FDF Field Manual	2015	-	-	Unknown	No	Official publication of FDF	FDF doctrine.
	Field Manual 2 - Military intelligence (restricted) [Kenttäohjesääntö 2 - Sotilastiedustelu (ST IV)] (translated by author)	FDF Field Manual	2015	-	-	Unknown	No	Official publication of FDF	FDF doctrine, FDF intelligence, FDF intelligence analysis.
	Field Manual 3.1 Army operations [Kenttäohjesääntö 3.1 Maaoperaatiot (ST IV)] (translated by author)	FDF Field Manual	2016	.	.	Unknown	No	Official publication of FDF	FDF Army doctrine.
	Field Manual No. 2-0: Intelligence	US Army Field Manual	2004	-	-	Unknown	No	Official publication of US Army.	Intelligence, intelligence analysis, US Army doctrine.
	https://en.wikiquote.org/wiki/Richard_Feynman	Webpage	2018	-	-	-	-	-	Used as quote to start chapter. Year marked as time of access.
	https://puolustusvoimat.fi/en/conscription	Web page	2018	-	-	Unknown	No	Official website of FDF	Only used for background information concerning conscription within the FDF.

Author(s)	Title	Type	Year	Journal	Jour-nal rating	Cita-tions	Refer-ences and sources	Assess-ment of quality	Other remarks
	Intelligence School training scheme 2019 (re-stricted) [Tiedustelukoulun koulutuskalenteri 2019 (ST IV)] (translated by author)	FDF order	2018	-	-	-	-	Official document (order) of FDF.	Used to describe training system for professional analysts within FDF.
	Physiopedia: Visual Analogue Scale [https://www.physio-pedia.com/Visual_Analogue_Scale]	Web publish	2017	-	-	-	Yes	Second-ary source.	Used to describe the VAS as a sec-ondary source and source for furthur information for intrested reader.
	Psychology Wiki: List of biases in judgment and decision making	Webpag e	2017	-	-	-	Yes	Assessed as valid.	Used as supportive source and sug-gestion for furthure reading for intrested reader.
	Publication Forum [https://www.tsv.fi/julkaisufoorumi/haku.php?la ng=en]	Web database	2018	-	-	-	-	Database by Publi-cation Forum.	Used to evaluate the reliablity of articles by searching for publishing journal quality in the database.
	Quick Wins for Busy Analysts	Book	2013	-	-	2	No	Assessed as valid.	Used for support on how analysts are training globally within the intel-ligence community. UK MOD.
	RECOBIA project website	Webpag e	2018	-	-	-	-	Assessed as valid.	Used to present larger project, which lead to publishment of nu-merous sources used.
	Report of the Select Committee on Intelligence on the U.S. Intelligence Community's Prewar Intelligence Assessments on Iraq together with Additional Views	Official docu-ment	2004	-	-	-	-	Assessed as valid.	Used as document to portray the change within the intelligence com-munity post 9/11.
	TENK: Humanistisen, yhteiskuntatieteellisen ja käyttäytymistieteellisen tutkimuksen eettiset periaatteet ja ehdotus eettisen ennakkoarvioin-nin järjestämiseksi [Ethical principles of research in the humanities and social and behavioural sciences and proposals for ethical review]	Official docu-ment	2012	-	-	-	-	Assessed as valid.	Used as basis for research ethics.

Author(s)	Title	Type	Year	Journal	Journal rating	Citations	References and sources	Assessment of quality	Other remarks
	TENK: Responsible conduct of research and procedures for handling allegations of misconduct in Finland - Guidelines of the Finnish Advisory Board on Research Integrity	Official document	2012	-	-	-	-	Assessed as valid.	Used as basis for research ethics.

There are a total of 142 sources evaluated, out of which four are only used for illustrative quotes. These are not considered in the statistics presented.

The following statistics are significant for evaluating the sources used as a body:

- 40 of the sources have been published in 2016 or later, eight have been published prior to 1980.
- 61 are scientific articles, 41 are books, seven are thesis from FNDU (GSOC or SOC), five are scientific papers, five are armed forces manuals, three are doctoral dissertations, three are official documents, and 13 are of various other types (webpages, other publications by e.g. the intelligence community).
- Ten sources have more than 10,000 citations.[265] 54 sources had less than ten citations or the number of citations was not available.[266]

Journal classification has three levels: 1 = basic; 2 = leading; 3 = top. If a publication does not have a classification but is identified, then it is marked with 0.[267]

The field “Other remarks” was used by the author to categorize the sources and present the fields where they were used.

[265] The number of citations for this table was collected from Science Direct and Google Scholar databases on 13 JAN 2019.
[266] The number of citations was not available through the used method for classified sources, official documents or webpages. This was taken into account when evaluating the trustworthiness of the source.
[267] Publication Forum [https://www.tsv.fi/julkaisufoorumi/haku.php?lang=en]. The publication forum is created and updated by the Finnish scientific community, which is governed by the Finnish scientific community law (938/2006) [Laki Tieteellisten seurain valtuuskunnasta] (translated by author) (http://www.finlex.fi/fi/laki/alkup/2006/20060938).

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This page is left intentionally blank due to restriction of the appendix (JULKL 24.1 § 10 k).

DATA COLLECTION TEMPLATES AND CRITERIA

1. Background questionnaire

GSOC 59
Captain Anssi Kaunonen
Helsinki .3.2018

BACKGROUND QUESTIONNAIRE

Respected analyst! This questionnaire is part of a thesis being conducted within the Finnish National Defense University, in which the effect of cognitive biases within intelligence analysis is inspected. The data of the thesis is collected in four phases during each case (=EX):

1) Background questionnaire
2) Observations made during the EX (incl. comparison of products made)
3) Final questionnaire
4) Final interview (Group interview).

You are part of the exercise in a capacity connected to intelligence. Thus, you are part of the subject group of the research. All material will be handed confidentially in accordance with the ethical guidelines of the Finnish Advisory Board of Research Integrity (FABRI). Your personal information will be used to identify you during the exercise - the information will however be anonymized immediately after the exercise. All material will be stored by the researcher. However, the report will not include information that could identify your identity, the identity of the troop taking part in the exercise or other similar information. The exercise command has given permission for this research.

Cognitive psychology has studied the functions of the human mind especially after the 1950's. Cognitive biases are caused by different processes, which our minds unconsciously use when processing information. The causes of biases are affected by the subject's background and natural attributes, professional training and experience of similar tasks. These are charted with this questionnaire. Please answer the questions on the following page with as much accuracy as possible.

You may choose to submit your email address, in which case the final (non-classified) report will be mailed to you in the autumn of 2019.

I'm happy to answer any questions concerning the research via email or telephone (anssi.kaunonen@mil.fi, 0299 482 111).

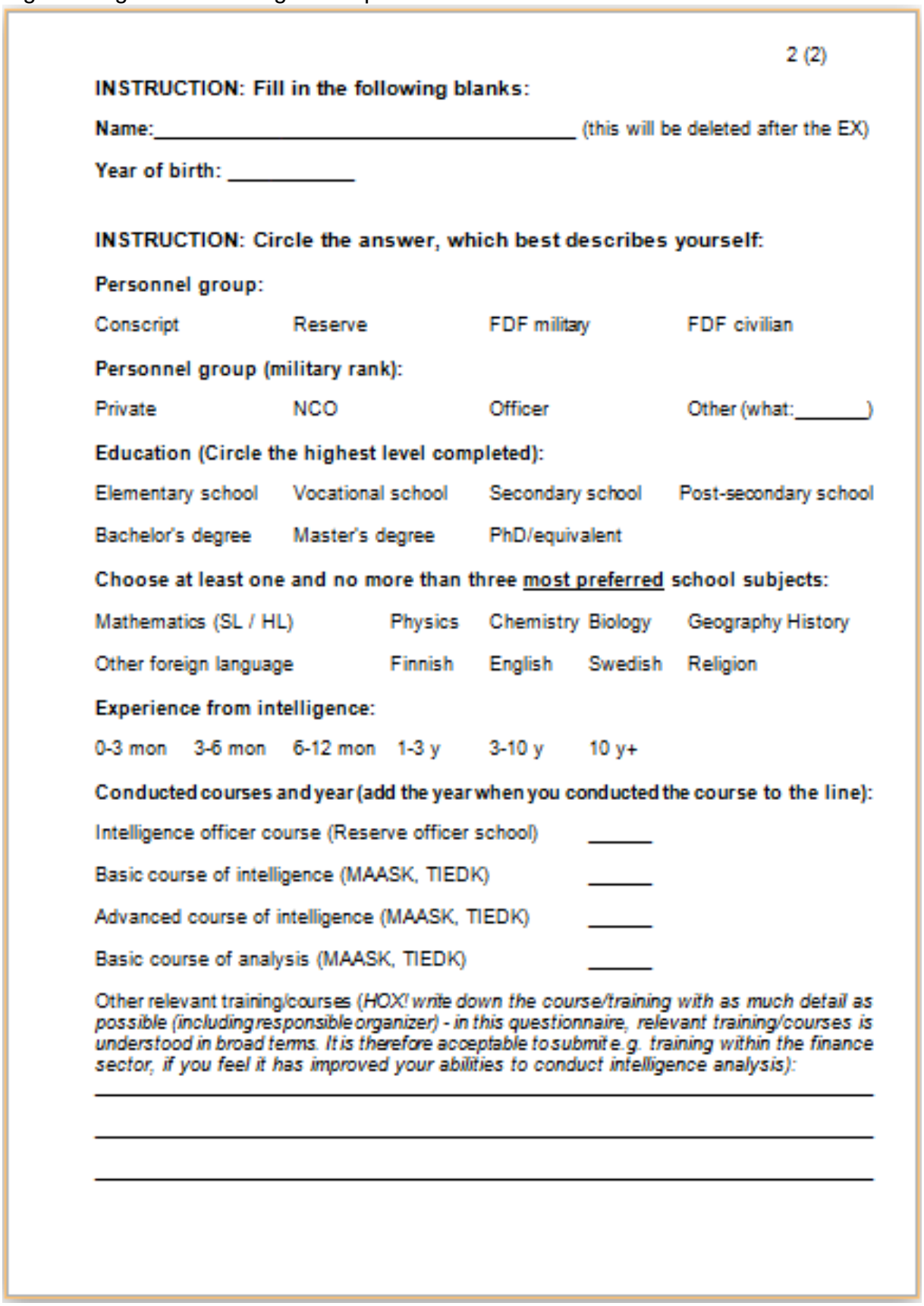
Thank you for your time!

Student officer (GSOC)
Captain Anssi Kaunonen

Fill the following blank, if you wish to receive a copy of the final report in 2019.

Email: _____

Figure: Page one of background questionnaire



2 (2)

INSTRUCTION: Fill in the following blanks:

Name:_____ (this will be deleted after the EX)

Year of birth: _____

INSTRUCTION: Circle the answer, which best describes yourself:

Personnel group:

Conscript Reserve FDF military FDF civilian

Personnel group (military rank):

Private NCO Officer Other (what:_____)

Education (Circle the highest level completed):

Elementary school Vocational school Secondary school Post-secondary school

Bachelor's degree Master's degree PhD/equivalent

Choose at least one and no more than three most preferred school subjects:

Mathematics (SL / HL) Physics Chemistry Biology Geography History

Other foreign language Finnish English Swedish Religion

Experience from intelligence:

0-3 mon 3-6 mon 6-12 mon 1-3 y 3-10 y 10 y+

Conducted courses and year (add the year when you conducted the course to the line):

Intelligence officer course (Reserve officer school) _____

Basic course of intelligence (MAASK, TIEDK) _____

Advanced course of intelligence (MAASK, TIEDK) _____

Basic course of analysis (MAASK, TIEDK) _____

Other relevant training/courses (*HOX! write down the course/training with as much detail as possible (including responsible organizer) - in this questionnaire, relevant training/courses is understood in broad terms. It is therefore acceptable to submit e.g. training within the finance sector, if you feel it has improved your abilities to conduct intelligence analysis):*

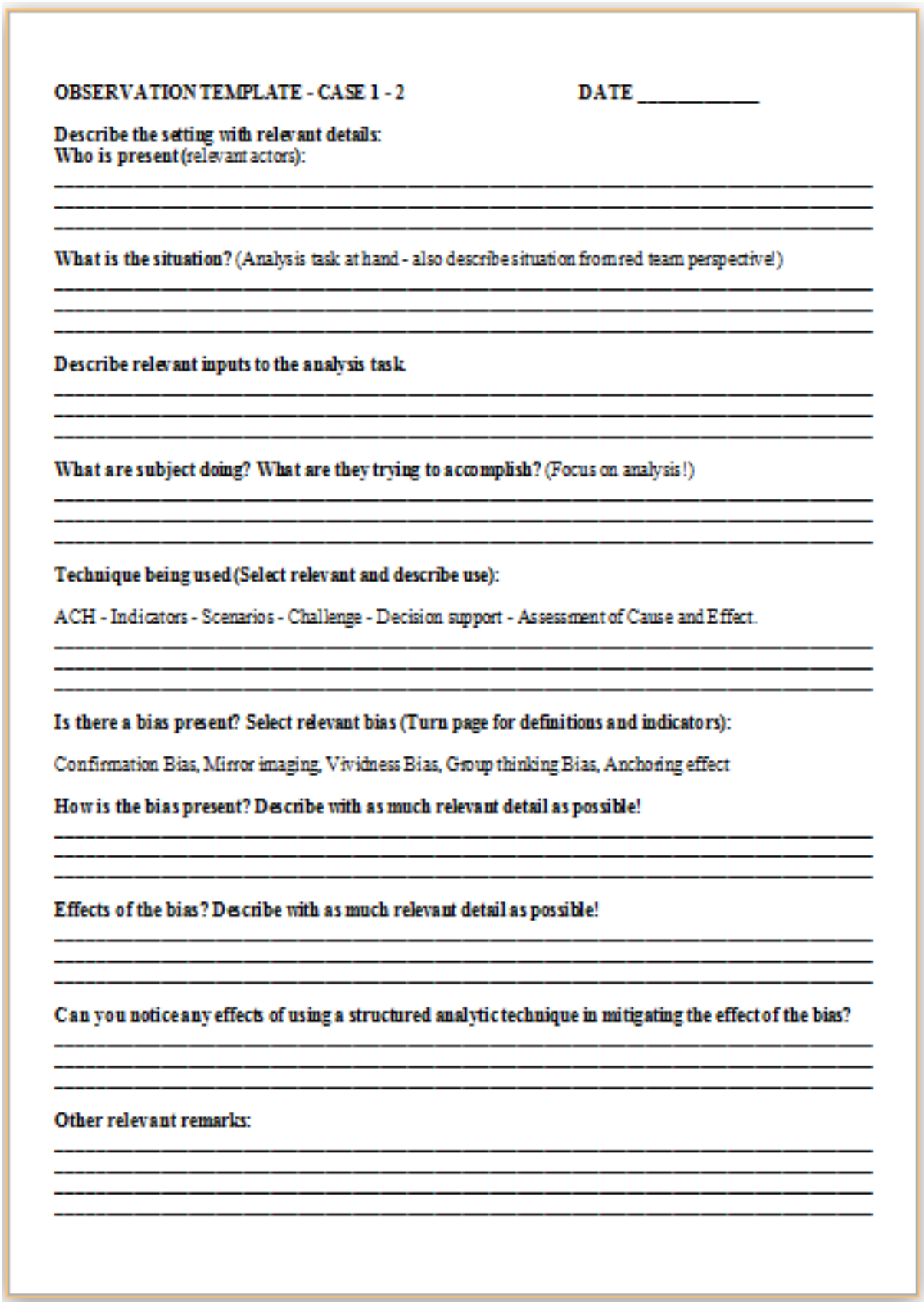
_____

_____

_____

Figure: Page two of background questionnaire

2. Observation template



OBSERVATION TEMPLATE - CASE 1 - 2 **DATE _____**

Describe the setting with relevant details:
Who is present (relevant actors):

_____
_____
_____

What is the situation? (Analysis task at hand - also describe situation from red team perspective!)

_____
_____
_____

Describe relevant inputs to the analysis task:

_____
_____
_____

What are subject doing? What are they trying to accomplish? (Focus on analysis!)

_____
_____
_____

Technique being used (Select relevant and describe use):

ACH - Indicators - Scenarios - Challenge - Decision support - Assessment of Cause and Effect.

_____
_____
_____

Is there a bias present? Select relevant bias (Turn page for definitions and indicators):

Confirmation Bias, Mirror imaging, Vividness Bias, Group thinking Bias, Anchoring effect

How is the bias present? Describe with as much relevant detail as possible!

_____
_____
_____

Effects of the bias? Describe with as much relevant detail as possible!

_____
_____
_____

Can you notice any effects of using a structured analytic technique in mitigating the effect of the bias?

_____
_____
_____

Other relevant remarks:

_____
_____
_____
_____

Figure: Observation template

3. After-action questionnaire

AFTER-ACTION QUESTIONNAIRE

Name:_____ (this will be deleted after the exercise)

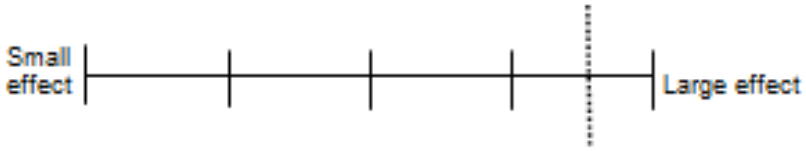
The purpose of this questionnaire is to gather your personal observations of cognitive biases and their effects within your work in the exercise. The questionnaire is divided into five parts; the top of each part will introduce a cognitive bias being observed in the exercise, after which you will be asked to submit observations concerning the presence of this bias and its' possible effects.

All material will be handed confidentially in accordance with the ethical guidelines of the Finnish Advisory Board of Research Integrity (FABRI).

Answering guide: Don't think of the answer for too long. Read the introduction and answer the questions with your first impression!

Answering guide: When a question has the options YES / NO, circle to appropriate answer.

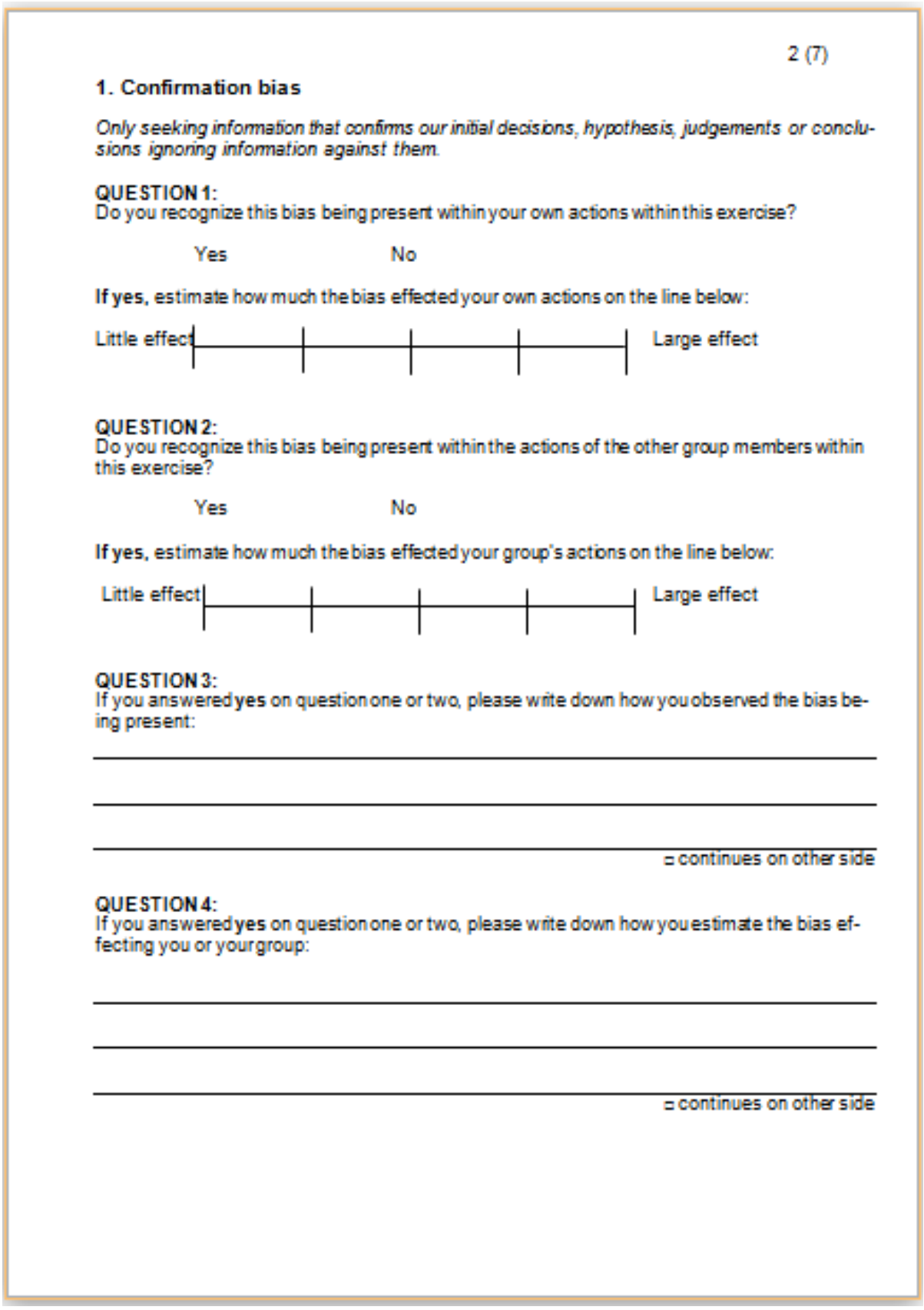
Answering guide: When you are asked to judge the effect of a bias on a line in accordance with the example below, draw a vertical line on point you judge to be most appropriate. There are five points marked on the horizontal line (beginning, ¼, ½, ¾, end). In the example below, the vertical line is drawn with a dashed line at a point, which indicates the bias having a large effect.



Answering guide: If you run out of space when answering an open question, you may continue answering on the back side of the paper. Mark which question you are answering on the back side in this case. Also check the box: "□ continues on back side" in this case.

Answering guide: At the end of the questionnaire there is space reserved ("Free text") for anything you want to bring up. This may be other observations, opinions, etc.

Figure: Page one of final questionnaire



2 (7)

1. Confirmation bias

Only seeking information that confirms our initial decisions, hypothesis, judgements or conclusions ignoring information against them.

QUESTION 1:
Do you recognize this bias being present within your own actions within this exercise?

Yes No

If yes, estimate how much the bias effected your own actions on the line below:

Little effect — Large effect

QUESTION 2:
Do you recognize this bias being present within the actions of the other group members within this exercise?

Yes No

If yes, estimate how much the bias effected your group's actions on the line below:

Little effect — Large effect

QUESTION 3:
If you answered **yes** on question one or two, please write down how you observed the bias being present:

□ continues on other side

QUESTION 4:
If you answered **yes** on question one or two, please write down how you estimate the bias effecting you or your group:

□ continues on other side

Figure: Page two of final questionnaire

The template of pages three to six are identical to page two of the final questionnaire. The difference between the mentioned pages is the bias being focused on. The definitions of the biases used are presented in chapters 3.4.1 - 3.4.5 of this thesis.

The final page (page seven) of the final questionnaire is a blank page, allowing participants to make any comments they feel relevant in the partition of “free text”. Participants are also thanked for their answers and time on this page.

THESIS OF CAPTAIN KAUNONEN APPENDIX 5

DATA COLLECTED FROM CASE ONE

Table 1. Results of questionnaire one (background questionnaire)

		Personnel group				Personnel group				Education (highest level)						Most preferable school subject (1-3)												Experience (within field)						Courses					
Label	Year of birth	Conscript	Reservist	FDF soldier	FDF civilian	Enlisted soldier	NCO	Officer	Other (what?)	Elementary school	Vocational school	Matriculation examination	Lowest higher education	Bachelor's degree	Master's degree	Doctoral/Licentiate degree	Math	Physics	Chemistry	Biology	Geography	History	Other foreign language	Native language	English (foreign language)	Swedish (foreign language)	Religion	0-3 months	3-6 months	6-12 months	1-3 years	3-10 years	10 years +	Intelligence officer course (RUK)	Intel basic course (MAASK, TIEDK)	Intel advanced course (MAASK, TIEDK)	Basic course, analysis (MAASK, TIEDK)	Other, what?	Other remarks
A	1992			x				x						x							x	x			x						x							x	Army academy, reconnaissance branch; Equipment and organization course 2017
B	1995	x						x						x				x	x	x								x										x	Medical doctor (Bachelor, medicine)
C	1998	x						x				x							x	x				x				x						x					2018

Table 2. Results of observation during exercise

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
Observation number	A	B	C	Confirmation bias	Mirror imaging	Vividness bias	Group thinking bias	Anchoring effect	ACH	Indicators	Scenarios	Challenge	Decision support	Assessment of Cause and Effect	Confirmation bias	Mirror imaging	Vividness bias	Group thinking bias	Anchoring effect		
1	X	X	X	X				X		X	X				Confirmation bias - trying to find information supporting the hypothesis of the probable course of action by the enemy.				Seeing the use of a certain type of equipment as only a protection force for the main assault. This was the primary idea, and is being focused on.		

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
2	X			X						X	X				All possible meanings are only being compared to the original red team "course of most probable actions" -> no other explanations are being looked at. Humor is being used to mask uncertainty within the situation, own forces are being looked at to explain possible movements of the enemy.					NIL - while analytic techniques are trying to be used, confirmation bias is causing the analysis to focus on only the primary assumption.	
3	X	X	X	X			X			X					Analysts are looking into the original data, not looking for alternative explanations			The group is searching for a consensus; alternative ideas are not being looked into.			

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
4	X	X	X	X	X	X			X						The primary hypothesis is trying to be proved, rather than all hypotheses trying to be disproved.	The question/comment "what would I do in this situation? - This makes no sense!" is heard numerous times during this discussion.	Information is being used to support the initial hypothesis - only the parts of information that supports this are being used.			Despite using competing hypothesis, the focus is on proving the initial hypothesis and not disproving all hypotheses!	
5	X	X	X	X			X								Analysts are seeking an explanation, that fits the current "set of mind".			Actors (especially A&C) are looking for a common view.			A&C exchange remarks on the importance of it being ok to be of a different view.
6	X							X											The original thoughts (analysis) are still strongly present and being worked on (as a basis), despite contradicting data.		Contradicting data is not presented within analysis products.

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
7	X	X	X	X			X			X					The primary red team LCOA is still driving the analysis of the data, alternative explanations are not being sought.			Analysts B+C primarily and A+B search for a common understanding, rather than trying to find alternative explanations.			
8	X	X	X	X	X				X	X					The first probable hypothesis becomes the strongest hypothesis, info supporting it is sought.	The question "how would I act in this situation" is being used constantly, the red team's view is not being examined.					
9	X	X	X	X					X						The initial LCOA of the red team is being focused on, other possible explanations are not being looked into.					As hypothesis aren't being disproved rather than proved, the structured technique isn't helping mitigate the effect of the bias.	

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
10	X	X	X	X				X		X					The primary hypothesis is still being emphasized, other hypothesis are not being looked into!				The primary hypothesis is still being emphasized, other hypothesis are not being looked into!		
11	X	X	X	X		X			X						Primary red team LCOA is the primary hypothesis, which is always seen as the most probable course of events. Secondary hypothesis are examined briefly, but quickly discarded.		Comparing to the red team LCOA, analysts are seeing the most likely course of events (as their primary hypothesis) as the only likely event. Other less likely scenarios are being discarded quickly.				
12	X	X	X		X		X									The actions of the red team are being put into the perspective of the blue team, rather than being examined as independent events.		A consensus is trying to be reached rather than different ideas being examined - the positive use of brainstorming			Brainstorming is being used as a technique.

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
																		is lost due to the bias.			
13	X	X	X		X				X	X						Analysts trying to understand the context through their own views rather than looking at the inputs through a new (red team) perspective.					
14	X	X	X	X				X	X						Due to the inputs not fitting into the primary hypothesis, inputs are being discarded. Alternative explanations or hypothesis are not being looked into, despite inputs being initially evaluated as trustworthy.				Due to the inputs not fitting into the primary hypothesis, inputs are being discarded. Alternative explanations or hypothesis are not being looked into, despite inputs		

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
																			being initially evaluated as trustworthy.		
15	X	X	X	X					X						Analysis is being conducted by going through the primary situation, and following up this hypothesis. Inputs that don't fit into this hypothesis are discarded, rather than other possible scenarios/hypothesis being examined.						

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
16	X	X	X	X					X						Analysts focusing on the primary hypothesis - other hypothesis are quickly discarded						
17	X	X	X	X					X						For the starting part of the analysis, only the primary hypothesis is considered. Other possible explanations are not examined.						
18	X	X	X	X			X		X						As before, analysts are sticking to initial assessment rather than trying to disprove different hypothesis.			The analysts are searching for a consensus, not looking for different ideas or explanations			The group is working fairly intensively together at this point. This is showing in the results, are the biases are repeating themselves for the same reasons (the group dynamics have been formed and are being followed).

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
19	X	X	X	X						X					Despite reaching the correct assessment in this case, analysts do not go through other possible scenarios, but rather jump to the first explanation that collectively comes to mind.						
20	X	X	X	X	X				X						The initial primary hypothesis is still being led as most probable	Red team actions are being evaluated with blue perspective, and not through known red team tactics etc.					
21	X	X	X	X		X			X						As before, new alternatives are not taken into account with the same seriousness as primary hypothesis, which was developed from the previous main hypothesis.		Only probable courses of action are taken into consideration, rare options (red team acting “outside the box”) are discarded as they emerge and not taken into hypothesis development.				

	Actors present			Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
SUM	21	19	19	18	5	3	5	4	12	8	2	0	0	0							
Percentage	100 %	90 %	90 %	86 %	24 %	14 %	24 %	19 %	57 %	38 %	10 %	0 %	0 %	0 %							

Table 3. Results of questionnaire two (final questionnaire)

			A	B	C	Results (amount)	Results (percentage)	Average
Confirmation bias	Personally	Yes/no	YES	YES	YES	3	100,00 %	
		If yes:	64	40	40			48
	Group	Yes/no	YES	YES	YES	3	100,00 %	
		If yes:	63	63	48			58
	How bias appeared?		-	For example when producing an estimate of red team COA, we looked at the text book model, and after that tried to confirm this.	Inputs of red team actions are frequently being ordered to fit my own impression of the situation.			

			A	B	C	Results (amount)	Results (percentage)	Average
	How bias affected?		-	When making different products, basically the first option was chosen and other options were automatically discarded.	At least at times my pattern of thought was narrowed, until I got an input that didn't fit into my pattern of thought in any way. At this point I was at least reminded of other options.			
Mirror Imaging	Personally	Yes/no	YES	Yes	YES	3	100,00 %	
		If yes:	34	39	47			40
	Group	Yes/no	YES	Yes	YES	3	100,00 %	
		If yes:	36	76	27			46,33
	How bias appeared?		-	I looked at the map through "red lenses" as I would have done myself - this method was used in all phases and with all products.	For example in one case when analyzing the situation and producing an estimate of red team actions, we frequently used the expression "this is what I would do in their boots". Of course, knowledge of red team tactics also was at the base of this work.			

			A	B	C	Results (amount)	Results (percentage)	Average
	How bias affected?		-	This lead to quicker work.	At least in the case I mentioned above, the product was better due to this technique.			
Vividness bias	Personally	Yes/no	No	No	No	0	0,00 %	
		If yes:	-	-	-			0
	Group	Yes/no	No	No	No	0	0,00 %	
		If yes:	-	-	-			0
	How bias appeared?		-	-	-			
	How bias affected?		-	-	-			
Anchoring effect	Personally	Yes/no	YES	No	YES	2	66,67 %	
		If yes:	62	-	53			57,5
	Group	Yes/no	YES	Yes	NO	2	66,67 %	
		If yes:	57	63	-			60
	How bias appeared?		-	When producing red team COA.	During the early phase of this EX, I personally noticed that I anchored myself into inputs that were readily available, but didn't have much significance. They however affected by thinking.			

			A	B	C	Results (amount)	Results (percentage)	Average
	How bias affected?		-	The first idea was the one we ended up using on the products, even though other options were possible.	Not in any significant way in my opinion.			
Group thinking bias	Personally	Yes/no	No	No	YES	1	33,33 %	
		If yes:	-	-	23			23
	Group	Yes/no	No	No	YES	1	33,33 %	
		If yes:	-	-	28			28
	How bias appeared?		-	-	If I personally didn't have a clear answer in a certain situation, then I easily "jump into the wagon" of somebody else's idea and begin to defend it.			
	How bias affected?		-	-	The leader of our group had his thought challenged fairly rarely, if at all. This is probably caused due to different levels of experience within the group.			

		A	B	C	Results (amount)	Results (percentage)	Average
Other remarks	[redacted]		Lack of time was a major factor with the biases - we settled into the first option that came to mind. Other options were looked into / pondered, but change of opinion from the original idea was far from happening. This was in a way an act - the first hypothesis/idea was never really challenged during this EX.		[redacted]		

THESIS OF CAPTAIN KAUNONEN APPENDIX 6

DATA COLLECTED FROM CASE TWO

Table 1. Results of questionnaire one (background questionnaire)

		Personnel group				Personnel group				Education (highest level)							Most preferable school subject (1-3)										Experience (within field)						Courses					
Label	Year of birth	Conscript	Reservist	FDF soldier	FDF civilian	Enlisted soldier	NCO	Officer	Other (what?)	Elementary school	Vocational school	Matriculation examination	Lowest higher education	Bachelor's degree	Master's degree	Doctoral/Licentiate degree	Math	Physics	Chemistry	Biology	Geography	History	Other foreign language	Native language	English (foreign language)	Swedish (foreign language)	Religion	0-3 months	3-6 months	6-12 months	1-3 years	3-10 years	10 years +	Intelligence officer course (RUK)	Intel basic course (MAASK, TIEDK)	Intel advanced course (MAASK, TIEDK)	Basic course, analysis (MAASK, TIEDK)	Other, what?	Other remarks
A	1981			x				x							x		x	x				x						x										
B	1980			x				x							x						x	x		x				x									x		2010
C	1977			x				x							x					x	x	x						x											
D	1979			x				x							x						x	x			x			x										x	EW (electronic warfare) course, 2006
E	1980			x				x							x						x	x						x											
F	1978			x				x							x				x		x			x								x				x		2007

Table 2. Results of observation during exercise

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
Observation number	A	B	C	D	E	F	Confirmation bias	Mirror imaging	Vividness bias	Group thinking bias	Anchoring effect	ACH	Indicators	Scenarios	Challenge	Decision support	Assessment of Cause and Effect	Confirmation bias	Mirror imaging	Vividness bias	Group thinking bias	Anchoring effect		
1	X	X			X				X	X				X						"How would I act?" is the question being spoken out most frequently	Analysts A+B are predominantly working on the task - as an observation, they are actively searching for a consensus, rather than challenging each other's thinking.			
2	X	X	X				X			X			X				X	Analysts have formed their initial assessment, which is being reinforced by all actors.			A consensus is being looked for, other possible COA are not being evaluated.			

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
3	X	X		X	X		X				X		X					The primary estimate (scenario) is being enforced, alternative explanations are not being considered.				The thought pattern of the analysts' has been locked to the primary explanation.		
4	X	X	X	X	X		X	X		X	X		X	X			X	Primary assessment is trying to be proved, alternative explanations are being discarded after single debates.	Blue team tactics are being used to explain red team actions (with have different basic tactics)		A consensus is trying to be reached (probably unintentionally/unconsciously), rather than alternative explanations being examined.	Primary assessment is trying to be proved, alternative explanations are being discarded after single debates.		

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
5			X	X	X		X			X				X				Even though the assessment is started with a blank paper, the analysis quickly moves into the form of the previously assessed probable red team COA. Own (blue team) situation is also quickly assessed, after which there is little discussion on the possible flaws of this assessment.			The group is searching for a consensus - alternative explanations are not being voiced out.		Potentially using scenarios should mitigate CB, if used without shortcuts. However, in this case the use isn't strictly structured, causing CB to effect the analysis.	
6	X	X					X			X	X		X	X				The primary assessment from the previous day is still the most predominant assessment, which is trying to be proved (using inputs to support this, even twisting data!)			The flow of the discussion is supportive; other contradicting possibilities are not brought up.	The primary situation from STARTEX is still dominating the thoughts of the analysts.	Use of indicators could potentially mitigate the effect of especially CB/AE, but the problem is that the data is being twisted to fit the original assessment.	

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
7	X	X	X	X	X	X	X	X		X			X	X			X	The primary conclusion is still being used as the primary assessment - alternative explanations are being quickly discarded.	Own methods and tactics are being used as a starting point, red team known tactics/methods are being evaluated less.		The group is searching for a consensus rather than seeking for alternative explanations.		Due to the elementary use of the techniques, they are not mitigating the biases. Further use of different techniques would force the structured use of data, but this is not the case at the moment.	
8	X	X	X	X	X	X	X			X	X		X	X				Analysts are focusing on the first scenario, seeking to confirm it.			As before, not looking for new ideas, but rather the group is searching for a consensus.	Analysts are focusing on the previous estimate, trying to prove it rather than thinking of alternative explanations.	Scenarios are being formed and evaluated. They are however trying to prove each scenario rather than disprove them. Indicators are being used to try to figure out the big picture - mostly focusing on known details (such as equipment type etc of known red team troops) to find trends.	The focus is on finding possible mistakes in the inputs. While this is somewhat useful in forming the big picture, it also con-

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
																								sumes much of the focus of the analysts, making them lose focus on the actual task.
9	X	X	X	X	X		X		X	X			X	X			X	The primary estimate from previous days is still the main focus, rather than looking into new possible courses of action with open eyes.		The first bit of information (a single input from higher command concerning a certain troop movement) is the most dominant factor in this analysis task. The other bits of information (even though they are rated with higher	The group is searching for a consensus, not radical or even contradicting ideas.		As earlier REPs, the use is not structured, but rather elements of the techniques are present. Thus the effect of biases is not mitigated.	

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
																			reliability) are not factored into the task with as much focus.					
10	X	X	X	X			X		X	X	X		X	X				Primary assessment stays the one most focused in, analysts trying to prove it rather than search for alternative explanations or disprove the primary assessment.		First input to arrive (higher echelon report) stays as the main focus (it was of great interest when it arrived, and stayed in focus), other inputs are used to	As earlier, the group is looking for a consensus.	Primary assessment stays the one most focused in, analysts trying to prove it rather than search for alternative explanations or disprove the primary assessment.	The observations have become fairly constant. Techniques (indicators, scenarios) are being used in some manner at all points, but in an unconscious manner. The use of elements of these techniques combined with strong use of intuition is causing all the selected biases to be present in this	

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
																			prove this view, rather than evaluate the "rightness" of it.			group.	
11	X					X	X	X	X				X	X				Primary estimates are still predominant.	Blue side tactics are juxtaposed on to red team actions.	The predominant information (FLASH report) is dominating the thinking process.				
12	X	X	X	X	X	X	X			X	X		X	X			X	The so called "single pattern of thought" was evident very quickly (more quickly than usually).			Due to the lack of time, a consensus was strived for ever more than earlier with this group.	As with confirmation bias -> especially after the first assessment of a plausible explanation was found, the analysts "locked in" into this, and		

	Actors present						Biases present					Techniques						How is the bias present?					Effects of structured analytic technique?	Other remarks
																					didn't ex-pand.		
SUM	11	10	8	8	8	4	11	3	4	10	6	0	10	10	0	0	5							
Percentage	92 %	83 %	67 %	67 %	67 %	33 %	92 %	25 %	33 %	83 %	50 %	0 %	83 %	83 %	0 %	0 %	42 %							

Table 3. Results of questionnaire two (final questionnaire)

			A	B	C	D	E	F	Results (amount)	Results (percentage)	Average
Confirmation bias	Personally	Yes/no	YES	YES	NO	YES	YES	YES	5	83,33 %	
		If yes:	65	62	-	69	52	100			69,6
	Group	Yes/no	YES	YES	NO	YES	YES	YES	5	83,33 %	
		If yes:	62	63	-	72	53	100			70
	How bias appeared?		Especially while working on estimates of red team actions, we focused on the basic model taught and tried to confirm this. This was partially caused by inexperience in the field.	When working on estimates, all the individuals working within the estimates had their own views, which they were trying to prove.	-	While working on estimate of red team LCOA, we were looking for inputs that confirmed our initial estimates.	Concerning certain events and future actions by the red team, we had some sort of initial idea. We as a group and as individuals tried to confirm this ideas.	Our estimates seemed to drag app. 24h. This was caused by our belief, that we would be getting some inputs from the "front" and "side" areas of the battlefield. When these inputs were lacking, our products dragged behind.			
	How bias affected?		Estimates were formed as "text book models", rather than actually looking in the inputs and analyzing them with an open mind.	The final product composed by the team was formed by the strongest views which were argued.	-	Negative impact: short term estimates were not as diverse or objective, as they should have been.	The bias must have affected us in a way: much discussion was done concerning each product, and the result of this discussion was the dominant idea that lead to the product.	Wrong/late/incomplete estimates.			

			A	B	C	D	E	F	Results (amount)	Results (percentage)	Average
Mirror Imaging	Personally	Yes/no	YES	NO	YES	NO	NO	YES	3	50,00 %	
		If yes:	88	-	61	-	-	75			74,7
	Group	Yes/no	YES	NO	YES	NO	NO	YES	3	50,00 %	
		If yes:	68	-	77	-	-	75			73,3
	How bias appeared?		My personal expectation was that others would have thought of red team actions as I did.	-	Reflecting my own thinking into the actions of the red team; this helped me work	-	-	Info sharing between different actors should be an automatic procedure. While this was lacking, we ended up filling in the gaps with our own experience.			
	How bias affected?		The effect was diminished with open discussion within the team, before actually submitting products into distribution.	-	In a positive manner, improving my analysis work and improving the quality of my analysis.	-	-	Delay in estimates.			
Vividness bias	Personally	Yes/no	YES	NO	NO	YES	YES	YES	4	66,67 %	
		If yes:	79	-	-	70	72	50			67,8
	Group	Yes/no	YES	NO	NO	YES	YES	YES	4	66,67 %	
		If yes:	53	-	-	60	52	50			53,8

			A	B	C	D	E	F	Results (amount)	Results (percentage)	Average
	How bias appeared?		A certain situation was estimated to be extremely unlikely within this frame. The situation however did happen, despite our estimates.	-	-	As stated earlier, red team actions were not analyzed with a broad mind, but rather only by using the "textbook" model and comparing inputs against it and only it.	If some red team action was estimated to be very dangerous for us, then the probability was typically exaggerated unconsciously.	In this case the tempo of the red team action was a personal surprise.			
	How bias affected?		The effect in the described situation caused errors in our estimates. The final effect within our battle was however not that great, as we had prepared for this unlikely situation by placing recce assets, which were able to give a warning of the event when it began to unfold.	-	-	Negative impact: red team estimates are not as useful, an are partially wrong, due to the bias.	This bias must have had a strong negative impact on both estimates or red team actions and on the situational awareness of the current situation.	This pattern caused a surprise for me - had I been able to estimate it more accurately, the action of our troop would have been different.			
	Personally	Yes/no	YES	YES	YES	NO	YES	NO	4	66,67 %	
		If yes:	87	75	85	-	86	-			83,3

		A	B	C	D	E	F	Results (amount)	Results (percentage)	Average
Group	Yes/no	YES	YES	YES	YES	YES	NO	5	83,33 %	
	If yes:	78	68	85	79	87	-			79,4
How bias appeared?		The starting point of the EX was the anchoring point of our products.	In a certain situation during the EX, the thought of a red team flank attack started to form. We "fell in love" with this idea, and hung on to it after the initial idea.	The starting point of the EX was the anchoring point of most of the analysis. This improved during the duration of the EX, but the effect was massive.	The estimate of red team actions provided by higher command was too dominant in our work - especially during the first phases of the EX.	Despite of the form of action done within our office during this EX, almost everybody clung on to their first "truth" in all situations.	-			
How bias affected?		The quality of our estimates. For example we clung on to red team troop numbers, which were given to us in a starting point estimate of red team actions, even though we were given no other inputs concerning these troops (despite having assets that should have been able to give	As above. The idea was kept alive by us, even though the inputs no longer supported it.	Negative impact - this bias caused much time consumption, as it took a long time to work out of the initial frame within the analysts' thinking pattern.	Many of our estimates were later proved wrong or outdated, but we clung on to them due to the way on how they were introduced to us.	There was a large impact on our products, as if and when we didn't question our own products, we ended in errors in our estimates.	-			

			A	B	C	D	E	F	Results (amount)	Results (percentage)	Average
			some sort of input on the issue).								
Individual bias	Personally	Yes/no	NO	YES	NO	NO	YES	YES	3	50,00 %	
		If yes:	-	59	-	-	28	50			45,7
	Group	Yes/no	YES	YES	NO	NO	YES	YES	4	66,67 %	
		If yes:	36	58	-	-	29	50			43,3

		A	B	C	D	E	F	Average Results (percentage) Results (amount)
	How bias appeared?	Within our group, the final estimates were often preluded by strong comments in behalf of this estimate model. We however of then clung onto the "text book model".	As with previous bias (Anchoring effect), we as a groupd fell in love with the idea and kept on feeding it.	-	-	Everybody within the group ended up looking for a group consensus at some point of the EX. I however question if this is a bias or just a social phenomenon.	As personal experience in this field is not as strong as I would like it to be, it caused me to stick to the consensus of the group. This lead to lack of "bravery" to point out alternative red team courses of action.	
	How bias affected?	I don't believe the final effect was very large.	As above, the group kept the idea alive.	-	-	We were looking for options and opinions, that would have had a positive impact on us - I however don't believe that this was a very large factor.	This bias caused conservative estimates especially in the early phases of the EX. This should have been tackled at the beginning.	

		A	B	C	D	E	F	Average Results (percentage) Results (amount)
Other remarks	[redacted]	If there had been a person within the group with extensive experience in these tasks, I believe they would have dominated the group. Now we used more discussion and teamwork to produce the estimates required.	The EX personnel was fairly inexperienced, which much have caused many biases and much of the work was done with intuition.	-	Two issues are emphasized in EX of this type: 1) many participants do not have actual work experience within the task they hold in the EX, and onsite training during the EX is usually fairly "light"; 2) the basic "laziness" of soldiers: the minimum required is quickly done, without putting too much effort into the task.	-	-	[redacted]