Sensemaking and Cognitive Bias Mitigation in Visual Analytics

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Abstract—The purpose of the project VALCRI is to develop a new system prototype for information exploitation by intelligence analysts working in law enforcement agencies. Information visualisation will be a core element of the prototype. Such systems have to be designed to support the sensemaking and reasoning processes of the analysts. One of the goals of the project is, therefore, to get a more thorough understanding of sensemaking processes and to develop a set of recommendations for the design of intelligence analysis systems to help analysts in their work.

I. INTRODUCTION

One of the main tasks of modern intelligence analysts is drawing defensible conclusions from available information. This task can be made easier by presenting the material in a way that supports human sensemaking and reasoning processes. Visualisation can play an important role here, but to achieve this goal it is necessary to understand human cognitive processes in this context. The purpose of the project VALCRI is to develop a new system prototype for information exploitation by intelligence analysts working in law enforcement agencies. One of the key problems is to 'connect the dots' or to quickly find the few pieces of relevant information from very large datasets (such as systems containing big data) and to piece them together so that it is possible to draw a sensible, reasonable and justifiable conclusion. Much of this process is presently very labour intensive and inefficient. When completed, VALCRI will integrate advanced and powerful data analytic software for automated extraction of meaningful information and related text, documents, images and videos, and for detecting signatures or patterns across multi-dimensional data that provide early warnings or triggers of impending criminal or terrorist action. Part of the project will involve the analysis of human reasoning processes and cognitive biases which might hinder analysts from drawing correct conclusions. The goal is to develop a set of guidelines and recommendations to help the analysts in their work and to design visualisations providing a comprehensive overview of the data.

II. SENSEMAKING AND COGNITIVE BIAS MITIGATION

Theories of sensemaking and cognitive bias mitigation are among the core foundations for this approach. From this research, recommendations for designing systems for intelligence analysis can be derived. Through a review of 120 case studies, Klein [1] found that "Insights change our understanding by shifting the central beliefs - the anchors - in the story (narrative) we use to make sense of events ..." (p148). Klein further recommends that systems designed for such use should "make it easy for users to shift goals and plans without getting disoriented." (p148). In VALCRI we propose investigating the validity of this proposition as a basis to design systems that would support discovery and insight generation by the easy and playful creation and assembly of tentative narrative explanations that can fluidly evolve into rigorous arguments. Further within VALCRI we propose that the underlying theory of gaining insights is Klein's data frame model of sensemaking [2]. This model enables us to view the process of human sensemaking in a very realistic rather than normative manner. It also provides a base to model confirmation bias which is believed to have an extremely significant influence in intelligence analysis. Solutions should, therefore, also aim to mitigate cognitive bias. Even though there has been a lot of research on different cognitive biases in the last few decades (e.g. [3]), no satisfying result has yet been reached. The number of cognitive biases to be mitigated is too large to get them under control with a simple strategy. Thus, we aim to develop new and combine tried and tested debiasing techniques to create software solutions that support human decision and sensemaking processes by considering various traps when drawing conclusions. The project has the ambitious goal of developing a tool that is sophisticated enough to meet the needs of criminal intelligence analysts while handling general cognitive failures using visualisations in big data will be met in the 4 years duration of the project VALCRI. For that purpose international experts in the fields of human cognition as well as visualisation and intelligence analysis will collaborate closely to take the research on human cognition to a new level.

ACKNOWLEDGEMENT

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