MACBETH: 
Development of a Training Game for 
the Mitigation of Cognitive Bias

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ABSTRACT

This paper describes the process of rapid iterative prototyping used by a research team developing a training 
video game for the Sirius program funded by the Intelligence Advanced Research Projects Activity (IARPA). 
Described are three stages of development, including a paper prototype, and builds for alpha and beta testing. 
Game development is documented, and the process of playtesting is reviewed with a focus on the challenges 
and lessons-learned. Advances made in the development of the game through the playtesting process are 
discussed along with implications of the rapid iterative prototyping approach.

Keywords: Case Study, Playtesting, Rapid Prototyping, Sirius Program, Training Video Game

DOI: 10.4018/ijgbl.2013100102
INTRODUCTION

While under constant pressure for quick and accurate judgments, intelligence analysts must gather information from a variety of sources, and rapidly process it incrementally as it is received. In his book The Psychology of Intelligence Analysis, Heuer (2006) refers to this process as “a recipe for inaccurate perception” (p. 27). As part of their work, intelligence analysts must not only evaluate the credibility of information they receive, they must also attempt to synthesize large quantities of data from a variety of sources, including intelligence collection assets from their own organizations, and from other agencies.

In their “Sirius” program, the Intelligence Advanced Research Projects Activity (IARPA) posed a challenge for researchers to create a training video game capable of prompting players to recognize cognitive biases within their decision making, so as to mitigate their occurrence during critical stages of intelligence analysis (IARPA, 2011). IARPA set forth a number of requirements for game development, including mandating which cognitive biases should be examined, while leaving research teams open to determining the form and content of their games, as well as the key theoretical mechanisms underpinning their design and function. Our team’s response was to develop a game called MACBETH (Mitigating Analyst Cognitive Bias by Eliminating Task Heuristics) in which players are challenged to gather and assess intelligence data to stop an imminent terrorist attack within a fictional environment.

This paper provides a design narrative (Hoadley, 2002) of a rapid prototyping, user-centered approach to developing MACBETH. It builds on (1) design narratives of rapid prototyping approaches to game design for learning (c.f., Aldrich, 2003; Jenkins, Squire, & Tan, 2004; Squire, 2008, 2010, 2011), (2) models of rapid prototyping within instructional design (Desrosier, 2011; Jones & Richey, 2000; Tripp & Bichelmeyer, 1990), and (3) modern versions of entertainment game design (Lebranade, 2010) to articulate an integrated approach to designing games for learning. This approach addresses the requirement that training games (1) must have mechanics appropriate to the target domain (2) suffice the requirements of multiple stakeholders, and (3) be backed by evidence that games are achieving their intended impact without causing unforeseen negative consequences. Before proceeding with these development issues, however, we first provide a brief overview of cognitive bias.

THEORETICAL APPROACH TO COGNITIVELY BIASED INFORMATION PROCESSING

A primary causal mechanism cited for biased information processing and poor credibility assessment is the reliance on heuristic social information processing—a nonanalytic orientation in which only a minimal set of informational cues are considered as long as processing accuracy is deemed sufficient. As defined by Chaiken’s Heuristic-Systematic Model of information processing (HSM; Chaiken, 1980; Todorov, Chaiken, & Henderson, 2002), heuristics are mental shortcuts, or simple decision rules, arising from conventional beliefs and expectations used repeatedly in daily interactions. In contrast to heuristic processing, systematic information processing requires more careful consideration of all available evidence, and is thus much more cognitively taxing (Chen & Chaiken, 1999).

The HSM posits that reliance on heuristics is often preferable because it minimizes cognitive effort while satisfying motivational concerns with sufficient reliability. Heuristics often provide swift solutions to complex, ill-structured problems (Silverman, 1992; Van Boven & Loewenstein, 2005), however, reliance on heuristics can also lead to insufficient consideration and/or disregard of relevant, diagnostic information. Consequently, although heuristics do not always lead to bias, an overreliance on them can result in decreased soundness of credibility assessments. According to the HSM, motivation, time, and ability to process information are critical elements for reducing
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