Computers in Human Behavior 37 (2014) 307–318

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Implicit and explicit training in the mitigation of cognitive bias through the use of a serious game

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ARTICLE INFO

Article history:

Keywords:
Video games
Cognitive biases
Training
Bias mitigation
Instructional testing

ABSTRACT

Heuristics can interfere with information processing and hinder decision-making when more systematic processes that might lead to better decisions are ignored. Based on the heuristic-systematic model (HSM) of information processing, a serious training game (called *MACBETH*) was designed to address and mitigate cognitive biases that interfere with the analysis of evidence and the generation of hypotheses. Two biases are the focus of this paper—*fundamental attribution error* and *confirmation bias*. The efficacy of the serious game on knowledge and mitigation of biases was examined using an experiment in which participants ($N = 703$) either played the *MACBETH* game or watched an instructional video about the biases. Results demonstrate the game to be more effective than the video at mitigating cognitive biases when explicit training methods are combined with repetitive play. Moreover, explicit instruction within the game provided greater familiarity and knowledge of the biases relative to implicit instruction. Suggestions for game development for purposes of enhancing cognitive processing and bias mitigation based on the *MACBETH* game design are discussed.

1. Introduction

Deliberative decision-making requires time and cognitive effort; therefore people regularly rely on heuristics—mental shortcuts—to make fast decisions. Heuristic processing of information may not be a problem when the stakes are low (i.e., when the cost of being wrong is insignificant) or when the heuristic aligns with the context. However, there are situations in which careful reasoning is required to make informed decisions, and over-reliance or misapplication of heuristics can lead to systematic cognitive biases and catastrophic outcomes (e.g., poor medical treatment, bad public policy, or even threatened national security).

Cognitive biases, or distortions in patterns of thinking, are very difficult to mitigate because people are usually unaware of their presence and operation. Moreover, decision makers are especially prone to biases when making relatively uncertain evaluations requiring large amounts of cognitive effort (Abelson & Levi, 1985). Research has shown that professionals and experts are no less likely to commit cognitive biases than ordinary people when making important decisions (Englich, Mussweiler, & Strack, 2006). Given the propensity for cognitive biases to short-circuit the effectiveness of everyday decision-making, the need for methods to mitigate their effects is constant. To this end, the present study examines the use of a serious video game to train people, such as intelligence analysts and policy makers, in the mitigation of cognitive biases. Intelligence analysts in particular must make quick decisions with very little information, and so are especially susceptible to cognitive biases (Heuer, 1999).

To increase systematic decision-making and reduce the prevalence of cognitive biases when analyzing intelligence information,

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http://dx.doi.org/10.1016/j.chb.2014.04.053
0747-5632/

we created a serious video game called *MACBETH* (Mitigating Analyst Cognitive Bias by Eliminating Task Heuristics). This paper presents the results of a multi-site experiment testing the ability of *MACBETH* to mitigate two specific biases described in the next section—the *fundamental attribution error* (FAE) and *confirmation bias* (CB).[2] Although others have attempted to reduce bias through a variety of training methods, the effectiveness of those attempts has been minimal and their lasting effects remain unclear (Dunbar et al., 2013). To our knowledge, no other experimental studies of video game training for the mitigation of cognitive bias have been published. The *MACBETH* case study can provide guidance for researchers attempting to train professionals about the nature of cognitive bias, while providing evidence for the efficacy of a novel, serious video game-based training method.

2. Theoretical approach

A primary causal mechanism cited for biased information processing is the reliance on heuristic social information processing, which, as described by Chaiken's heuristic-systematic model (HSM; Chaiken, 1980; Todorov, Chaiken, & Henderson, 2002), is a nonanalytic orientation relying on a quick and minimally careful consideration of informational cues. The HSM defines heuristics as mental shortcuts, or simple decision rules arising from conventional beliefs and expectations used repeatedly in daily interactions. In contrast to heuristic processing, systematic social information processing requires more careful consideration of all available evidence and is much more cognitively taxing (Chen & Chaiken, 1999). An over-reliance on heuristics when useful information is available can lead to biased information-processing and a range of suboptimal decisional outcomes, including faulty reasoning, and a failure to make sound credibility judgments. People may often erroneously believe they are making decisions based on sound evidence when in fact they are actually making guesses. According to the HSM, only if adequately motivated, with sufficient time and ability to process information, will individuals choose to engage in systematic processing. Thus, both the motivation and ability to process information are critical for reducing analytical over-reliance on simple heuristics (Todorov et al., 2002).

The *MACBETH* game was designed to train players on two particular biases: FAE and CB, the later of which is the tendency to search for or interpret information in a way that confirms one's preconceived assumptions, biases, expectations, or hypotheses (Nickerson, 1998). When faced with multiple possibilities, CB lowers the probability that one's initial hypothesis will be rejected (Oswald & Grosjean, 2004; Watson, 1960).

Several studies have examined ways to mitigate the negative effects of CB in similar investigation tasks (Hill, Memon, & McGeorge, 2008; Krems & Zierer, 1994; Oswald & Grosjean, 2004; Rassin, 2010). For example, O'Brien's (2009) study of CB in criminal investigations demonstrated that participants who considered why their hypothesis might be wrong showed less bias, whereas those who generated several additional hypotheses did not, suggesting that too many alternatives or too much high task complexity can hinder one's systematic processing ability. In more complex tasks such as the intelligence gathering and analysis task tested here, information consistent with alternative hypotheses has the effect of prematurely reifying the original hypothesis (O'Brien, 2009). Games are ideal settings for training about CB because players can be prompted to offer alternative hypotheses when new information is received or can be encouraged to delay making hypotheses before sufficient information is known.

[2] The game was also designed to mitigate the bias blind spot (BBS), but the BBS results are presented elsewhere due to space limitations and because a different game mechanic not described here was used for BBS.

The second bias we examined was the FAE, which is the tendency for people to over-emphasize stable, personality-based explanations for behaviors observed in others—referred to as dispositions—while under-emphasizing the role and power of transitory, situational influences on the same behavior (Harvey, Town, & Yarkin, 1981; Mowday, 1981). However, if a behavior is truly caused more by dispositions or other personality variables, then using those dispositions to explain a behavior would not be in error (Gifford & Hine, 1997). The problem lies in the general tendency of humans to overlook situational variables while emphasizing and prematurely attributing causes to dispositions, regardless of whether they are the true or only causes of the behavior in question. This cognitive neglect can be explained by the HSM, since dispositional attributions are simpler, demand less effort, and may satisfy decisional needs more easily than expending the time and energy required to investigate situational and/or contextual explanations for relevant behaviors. For example, if you discover a falsehood, it is easier to explain that behavior by calling someone a "liar" than to uncover the reasons behind the lie (O'Sullivan, 2003). This form of FAE is exacerbated when making judgments about the motives of others, since it is more difficult to access the situational factors associated with others' behaviors relative to one's own behaviors.

As with the mitigation strategies for CB, exploring other situational hypotheses should make analysts aware of their tendency to rely on dispositions, and instead, make them rely more on well-reasoned judgments. In addition, Hodgins and Knee (2002) suggested that openness to experience, an aspect of mindfulness (characterized by attentiveness and awareness), attenuates cognitive defensiveness such as using self-serving bias and stereotyping. Another study found that mindfulness when receiving a negative evaluation can reduce hostile attribution bias and aggressiveness (Heppner et al., 2008). Games can train players to learn the difference between situational and dispositional information and mitigate the FAE by encouraging mindfulness in decision-making through rewards in the game.

3. Experiential learning of biases through video games

Video games are ideal media for learning and mitigating cognitive biases because their interactivity facilitates experiential learning. Hands-on experience is at the heart of many learning theories (see Kolb, 1984). These theories argue that learners will have a deeper understanding of the issue through the experience of problem solving, experimenting with different solutions, and observing the consequences of their decisions. According to Hoover and Whitehead (1975) "Experiential learning exists when a personally responsible participant cognitively, affectively, and behaviorally processes knowledge, skills, and/or attitudes in a learning situation characterized by a high level of active involvement" (p. 25). Since decision-makers are often unaware of their cognitive biases, experiential learning is necessary for mitigating cognitive biases because it allows decision-makers to actively process information, make decisions, and observe the consequences of their actions. Since decision makers are personally responsible for their decisions and resulting consequences, this experience is more likely to make them aware of their own biases and actively practice mitigating them. This is especially true in the area of intelligence analysis where mistakes can be grave, so making and learning from these mistakes in a safe environment is more desirable than learning about them from suffering their consequences in the real world.

Video games can support experiential learning through simulating real decision-making scenarios, providing dynamic feedback, providing opportunities to experiment with different action, and