Mitigation of Cognitive Bias with a Serious Game:
Two Experiments Testing Feedback Timing and Source

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ABSTRACT

One of the benefits of using digital games for education is that games can provide feedback for learners to assess their situation and correct their mistakes. We conducted two studies to examine the effectiveness of different feedback design (timing, duration, repeats, and feedback source) in a serious game designed to teach learners about cognitive biases. We also compared the digital game-based learning condition to a professional training video. Overall, the digital game was significantly more effective than the video condition. Longer durations and repeats improve the effects on bias-mitigation. Surprisingly, there was no significant difference between just-in-time feedback and delayed feedback, and computer-generated feedback was more effective than feedback from other players.

KEYWORDS
Cognitive Bias, Confirmation Bias, Feedback, Fundamental Attribution Error, Training Game

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INTRODUCTION

Proponents of digital game-based learning maintain that games and simulations can facilitate learning because they (a) cater to the digital generation of learners (Prensky, 2005), (b) allow for immersive, active learning increasing engagement and retention, and (c) encourage new forms of knowledge interaction unavailable in a traditional curricula (e.g., perspective-taking, slowing down or speeding up time processes, accessing hazardous or distant environments (Jackson, 2008). Importantly, digital games allow for immediate feedback that can help learners correct their mistakes and reward learners for making correct decisions.

The provision of feedback generally improves learning, however there are important caveats regarding how and when feedback is given. Digital games can provide feedback based on learners’ pace and decision making (Azevedo & Bernard, 1995). Recent studies have examined the costs and benefits of offering feedback during instruction (Hays, Kornell, & Bjork, 2010), the timing (Butler, Karpicke, & Roediger, 2007) and the source of feedback (e.g., a teacher, parent, peer, or a computer agent in the game (Goldberg & Cannon-Bowers, 2015; Hattie & Timperley, 2007). We add to this body of research by presenting two studies exploring the effects of feedback timing (immediate vs. delayed) and feedback source (computer agents vs. human partners) in a game-based learning environment designed to teach learners about the pitfalls of cognitive biases. To test these effects, we created a serious game called MACBETH (Mitigating Analyst Cognitive Bias by Eliminating Task Heuristics), wherein players are tasked with detecting and preventing a series of terrorist threats by gathering and assessing intelligence data (for MACBETH development see author citation). The game focuses on knowledge and mitigation of confirmation bias (CB) and fundamental attribution error (FAE). The training effectiveness of the game was compared to a traditional instructional video explaining FAE and CB, which of course excluded feedback.

Using Feedback in a Serious Game to Mitigate Cognitive Biases

Biased information processing is often caused by the over-reliance on heuristics—defined as mental shortcuts, or simple decision rules—arising from conventional beliefs. By providing swift solutions and minimizing cognitive effort, heuristics can benefit decision-making; however, they may often also lead to insufficient consideration of relevant, diagnostic information, resulting in increased use of cognitive shortcuts associated with poor decisions and biased information processing (Tversky & Kahneman, 1974). Confirmation bias harms systematic information-processing by directing attention toward evidence that confirms existing attitudes and beliefs (Lundgren & Prislin, 1998) at the expense of weighing and examining pertinent available evidence that might otherwise disconfirm erroneous assumptions. Similarly, FAE fosters a tendency to focus on internal, dispositional explanations of others’ behaviors at the expense of external, situational factors (Harvey, Town, & Yarkin, 1981) likewise hindering the decision-making process.

Cognitive biases are difficult to change: They are deeply embedded within natural cognitive processes, and people rarely recognize their biased decision-making. To mitigate bias, people must first become aware of their use of heuristics (Bornstein & Emler, 2001) for which feedback can help, thereby leading to better-informed decisions. Feedback in game-based learning can be effective when it provides players objective learning goals with clear criteria for success, along with methods for improvement to attain goals (Erhel & Jamet, 2013).

Not all feedback benefits learning: Repeated negative feedback, for instance, can lead to lowered expectations, reduced effort, and a more negative self-image (Krenn, Würth, & Hergovich, 2013). Formative and corrective outcome feedback through suggestions and guidance can help modify
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