# 13. Mitigating Bias and Improving Professional Decision-Making through Persuasive Training Games

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**Abstract**
Making accurate, unbiased decisions is critical in high-stakes professions such as law enforcement, intelligence analysis, and medicine, since the decisions can have severe consequences. In this chapter, we discuss what makes persuasive games effective for training professionals to recognize their cognitive biases, improve their knowledge about decision-making biases, and learn ways of mitigating bias. We describe our experience designing three games for professional training in cognitive biases and deception detection. This chapter focuses on the combination of decision-making, education, and game theories that drives our design. This is then followed by a discussion of our experiments and measurements for testing the effectiveness of our designs.

**Keywords:** cognitive bias; decision-making; training; deception

## Introduction

Many professions require the processing of information from multiple sources and the making of rapid decisions under pressure. Making accurate decisions is especially crucial in high-stakes settings such as law enforcement, intelligence analysis, and medicine. Since high-stakes decisions often have grave consequences involving life and death situations, one would expect professionals in these fields to make unbiased decisions by

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considering all available information, treating evidence fairly, and rationally weighing all the relevant costs and benefits. Research has shown, however, that due to the rapid-response nature of these kinds of judgments, decision-makers often rely on heuristics, especially when in unfamiliar situations that require careful, deliberative processing (Hicks & Kluemper, 2011; Heuer, 1999).

Heuristics are mental shortcuts, or rules of thumb, that simplify decision-making by reducing the amount of information required for processing (Tversky & Kahneman, 1974; Chaiken, 1980). Most of the time, heuristics help professionals to make efficient judgments that are reasonably accurate. However, in unfamiliar situations, where careful, deliberative evaluations are required, relying on heuristics can lead to systematic cognitive biases and significant adverse consequences. Studies have shown, for example, how medical professionals often make premature diagnoses as a result of various cognitive biases (Graber, Franklin, & Gordon, 2005). Bias can also cloud judges and jurors' memories of factual details during legal trials (Levinson, 2007).

Heuristics and cognitive biases are difficult to avoid because most people are unaware of their own biases (Pronin, Lin, & Ross, 2002). Indeed, even when reminded and cautioned about their overuse of heuristics, people often lack the motivation to inhibit them due to the convenience they bring to the decision-making process (De Neys, Vartanian, & Goel, 2008). Currently, organizational workshops and static, non-interactive instructional materials (e.g., videos and handouts) are the most common training formats for educating professionals about their cognitive biases. However, meta-analyses of studies on de-biasing training, especially in deception detection, indicate that the effects of traditional approaches are only small to moderate at best, depending on how the training is conducted (Driskell, 2012; Hauch et al., 2016). Decision-making training programs are more effective when they are relevant to real-world scenarios, teach diagnostic cues, allow the practicing of decision-making, and incorporate immediate feedback (Vrij, 2008; Frank & Feeley, 2003).

We argue that digital games are effective training tools for mitigating bias and improving professional decision-making because of their ability to simulate real-world problems while providing tailored, individual feedback to players (Dunbar et al., 2018; Dunbar et al., 2014; Lee et al., 2016; Bessarabova et al., 2016). Below we list some reasons for adopting digital games in professional training.

(1) *The simulation of real-life scenarios*: Digital games can simulate high-stakes decision scenarios without resulting in actual life-and-death consequences. Games also allow for the simulation of rare or expensive scenarios,

so that professionals can practice making decisions under extreme and challenging conditions. It would be very costly and dangerous for surgeons to practice on actual patients during early training or for law-enforcement recruits to engage with dangerous criminals. A game simulation, however, can offer such challenges within a safe and controlled environment.

(2) *Systemic thinking*: Digital games are especially good at facilitating complex and dynamic systems-thinking (Squire, 2006). Games allow players to build mental models of interacting factors by visualizing the variables, manipulating the factors, and observing the changes. Thus, a game like *SimCity* allows players to learn the relationship between budgets and policies and to understand how each decision can cause a chain reaction that affects further outcomes based on players' decisions.

(3) *Personal feedback*: Digital games can give immediate feedback to players about their performance and decisions (Azevedo & Bernard, 1995). They can also provide formative, corrective feedback following key decisions that are taken or not taken. This gives players information about potential outcomes, enabling them to reconsider their decisions and make adjustments within a dynamic, ongoing, interactive process.

(4) *Autonomy*: While not all persuasive games are played voluntarily, almost all of them involve choice and provide some level of autonomy and agency for players (Ryan, Rigby, & Przybylski, 2006). The freedom to make choices that have an effect on the environment—and on others with whom one is interacting within a video game—can be a powerful source of enjoyment (Klimmt, Hartmann, & Frey, 2007), further stimulating intrinsic motivation.

(5) *Community-building*: Many approaches to training involve team-building games to facilitate trust, foster cohesion, and create a community of like-minded individuals sharing similar goals. Digital games can create strong senses of community and identity, with people coming together to discuss issues and problems experienced within a game (Gee, 2007). Games are fundamentally creative problems to be solved. To unravel and resolve in-game problems, players work together to actively process information in the simulated environment, learn about its rules, and pick up on relevant skills as they progress.

Overall, the procedural nature of digital games allows immediate and individualized corrective feedback about a player's progress and performance (Bogost, 2007), providing an opportunity to assess and alter decisions (Billings, 2010). Moreover, because games incorporate designs that support and encourage self-determination—such as competence, autonomy, and relatedness—they tend to be more intrinsically motivating, resulting in the greater internalization of relevant training materials (Tamborini et al., 2010; Ryan, Rigby, & Przybylski, 2006). Taken together, the features of persuasive games offer the potential for bias mitigation and decision-making training.

Based on our team's experience of designing and testing three different persuasive games developed for the law enforcement and intelligence communities, this chapter focuses on the benefits of using digital games to train professionals to avoid biases and heuristics in order to improve their decision-making. We start the chapter with a description of the games that our teams developed, followed by a discussion of the measurements and theory-driven designs that made the exploration of the effects of persuasive game possible. We conclude with a description of our research findings that together point to the effectiveness of employing persuasive digital games for bias mitigation and deception-detection training.

## Persuasive games

### MACBETH

The first bias persuasive training game we developed was called MACBETH (Mitigating Analyst Cognitive Bias by Eliminating Task Heuristics) and was funded by the Sirius game program of IARPA (Intelligence Advanced Research Projects Activity). The goals of the research were to test the effectiveness of digital games for teaching intelligence analysts about cognitive biases and to improve their decision-making processes. MACBETH addressed three types of bias: *confirmation bias* (i.e., the tendency to select or interpret information that confirms one's values, attitudes, or beliefs); *fundamental attribution error* (i.e., the tendency to attribute other people's behavior to dispositions and to underemphasize situational factors); and *bias blind spot* (i.e., the inability to see one's own biases while being aware of those in others).

MACBETH was designed as a turn-based strategy game in which players take on the role of an intelligence analyst attempting to prevent a potential terrorist attack. The nine scenario narratives and game contexts were designed to mirror the problems that intelligence analysts face in real life and to increase skill transfer from the game to their actual work. In the game, a short description of cognitive biases was provided in the introduction. To prevent a terrorist attack, players had to gather intelligence from multiple sources to generate their hypotheses about

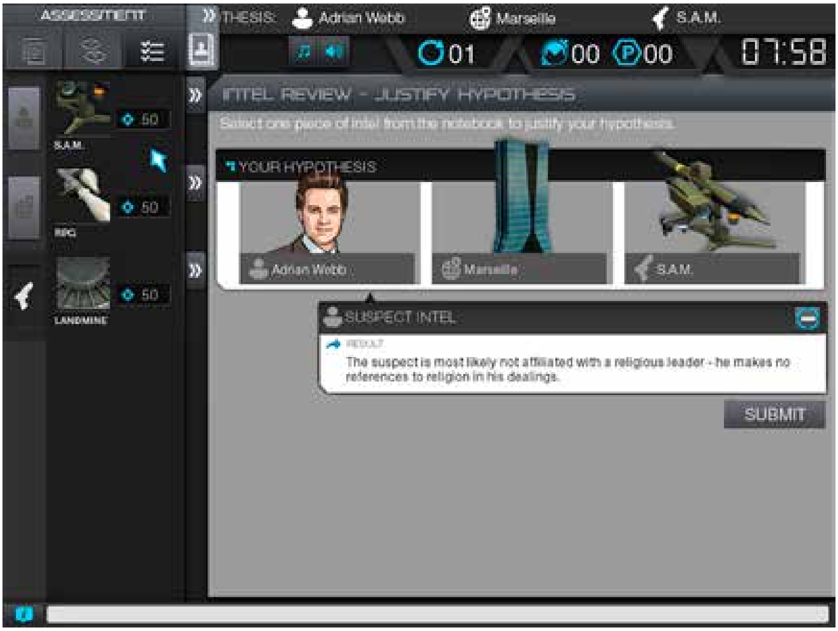


Figure 13.1

the suspect, the location, and the means of the attack. To win the game, players had to distinguish between biased and unbiased intelligence and rely on the latter to make their decisions. See Figure 13.1 for a screenshot of MACBETH.

To reduce confirmation bias, MACBETH provided players with feedback encouraging them to delay forming hypotheses while searching for more disconfirming information that would be helpful for formulating alternative hypotheses. To reduce fundamental attribution errors, a mini-game was developed wherein players read through old case files that described historical figures, some of whom were actual criminals and terrorists. To succeed, players needed to select information that was diagnostic when it came to correctly identifying historical characters as threats, with points awarded for choosing situational clues over dispositional versions (see Dunbar et al., 2014 for more details). To reduce bias blind spots, the goal was to demonstrate to players that they are just as susceptible to bias as everyone else. The presence of bias was communicated both implicitly by taking points off for biased decisions (and in some cases through losing a particular level within the game) and more explicitly by giving players feedback about the different types of bias they exhibited as they occurred (see Bessarabova et al., 2016 for more details).

## MACBETH 2

The second game, MACBETH 2 (also funded by IARPA, with supplemental funding from the University of Oklahoma), was designed to address three different types of cognitive bias: *anchoring bias* (i.e., the tendency to overemphasize the first piece of information received by anchoring subsequent judgments to it, leading to overestimates or underestimates); *projection bias* (i.e., the tendency to project oneself onto others when making judgments); and *representativeness bias* (i.e., the tendency to ignore statistical probabilities in favor of contextual cues). Representative bias can be further divided into four subtypes: stereotyping (i.e., overgeneralizing attributes based on group characteristics); insensitivity to sample size (i.e., overgeneralization from small samples); base-rate fallacy (i.e., disregarding the probability of outcomes and focusing on descriptive information to estimate probabilities); and gambler's fallacy (i.e., the misconception of chance, or the tendency to expect a sequence of random events to be non-random, such as when expecting a higher chance of winning after a series of losses).

In an attempt to counteract these biases, the design of MACBETH 2 was similar to MACBETH but with a few changes. First, players were tasked with instructing a field agent to move around in a virtual environment to gather information about a series of international contraband trafficking cases. Next, players were asked to determine if the information the agent gathered was biased or not. In addition to making judgments about the information, players also had to identify which kind of bias was involved in the field agent's various decisions. Once a certain amount of information was collected, the player took the intelligence into consideration and assessed whether the suspect being investigated in each scenario was a threat or not. See Figure 13.2 for a screenshot of MACBETH 2.

We used a multiple-choice question format for anchoring bias mitigation. In the game, players were exposed to the field agent's estimates (i.e., an anchor) that were unrelated to the decision being made, and they needed to produce an estimate without being influenced by the irrelevant anchor. To facilitate this, we used a consider-the-opposite strategy developed by Mussweiler, Strack, and Pfeiffer (2000) to train players on anchoring bias. Before the players made the estimate, they received a multiple-choice question, providing one answer in which the anchor was relevant to the estimate and three suggesting that the anchor was irrelevant to the targeted estimate. The goal was to prompt players to consider alternative explanations and separate the anchor from their estimates.

Figure 13.2

We employed two separate strategies to mitigate representativeness bias. The first addressed stereotyping and base-rate fallacy. The game asked players to read feedback about biased intelligence in which various descriptions were included along with base-rate statistics relevant to how the information might be biased. The players were encouraged to take the base rate into consideration instead of relying solely on the representative descriptions. The second strategy addressed the gambler's fallacy and insensitivity to sample size. The game provided players with two similar examples of a situation, after which the field agent offered his or her assessment of the pattern observed from the previous scenarios. Players could choose to reject the agent's assessment based on the small sample sizes observed, thereby considering chance rates instead of the proffered patterns (see Lee et al., 2016 for more details).

## VERITAS

Our third game for professional training is called VERITAS (Veracity Education and Reactance Instruction through Technology and Applied Skills) and was funded by a grant from the National Science Foundation's Cyberlearning and Future Learning Technologies program. The goal was to design and test a game to teach deception-detection skills to law enforcement officers. In real-world decision-making, deception is very difficult to detect, and professionals are known to rely on stereotypes and biases that are not based on reliable cues (Vrij, 2008). We trained players to identify clusters of verbal and non-verbal cues that indicated tension, uncertainty, and the

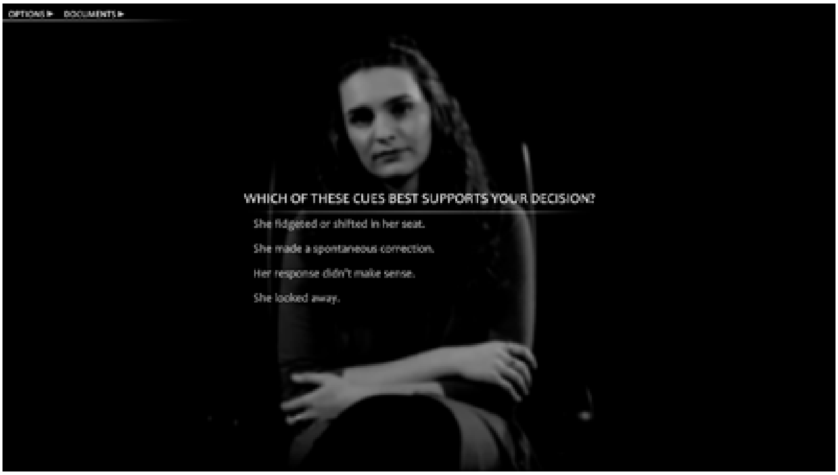


Figure 13.3

high cognitive load that is more likely to be associated with deception than truthfulness (Dunbar et al., 2018).

In VERITAS, two actors played characters in two game scenarios: a job interview and a workplace theft investigation. The purpose of using real actors rather than computer-generated characters was to enhance the training effects by more accurately depicting the verbal and non-verbal truth and deception cues while avoiding uncanny valley effects (i.e., a dip in the player's affinity for a computer-generated character due to its eeriness). In the game, players take on the role of the interviewer and select questions to ask the interviewees from a series of options. See Figure 13.3 for a screenshot of VERITAS.

The game reacts to player questions using a dialog tree that answers with pre-recorded responses performed by the actors. For each answer, players are asked to assess whether the statement is truthful or deceptive and to report their degree of confidence in each judgment. The players must also indicate which cues they relied on to form their judgments. The training begins with a brief instructional video in the game that teaches players what cues to look for instead of relying on stereotypes or myths about deception. The first half of Scenario 1 serves as a baseline assessment of the player's deception-detection skills. The player is given performance feedback midway through this scenario. Afterwards, the players receive formative feedback about their judgments, explaining why they were correct or incorrect and what cues they should have focused on or ignored.

## Theory-driven design and measurements

A key to designing games for professional training is to ensure that the learning effects can transfer to real-world scenarios and last beyond the immediate training session. Other considerations involve testing whether the game can be as effective as traditional instructional methods like lectures and videos. To increase intrinsic motivation within the game, it is also important to determine how best to reduce possible negative reactions (i.e., psychological reactance) that arise due to potential controlling influences within the training environment. Theories of learning, bias mitigation, and social influence were incorporated into each game to achieve these goals. These theory-based approaches are detailed further below.

To improve knowledge and skill transfer, early theories of learning highlight the importance of including common features within the training to facilitate transfer by helping learners make associations between the features (Thorndike & Woodworth, 1901). More recent theories regarding skill learning argue that training mechanics should help learners to build mental models that are transferable to real-life scenarios. The training should also feature a certain amount of variability so that pertinent knowledge and skills are not tied to specific scenarios but can be generalized to new and changing circumstances (Burke & Hutchins, 2007). We designed our games' contexts based on these concepts in order to mirror the challenges within real-life scenarios faced by professionals each day. In MACBETH and MACBETH 2, players adopt the role of an intelligence analyst, whereas in VERITAS they assume the role of an interviewer evaluating an interviewee or a potential suspect in a crime. In terms of game mechanics, since the focus is on decision-making rather than navigating virtual environments, a turn-based puzzle/strategy format was chosen so that players could more carefully focus on managing a significant amount of information during the decision-making process. In all three games, multiple scenarios were designed to vary in terms of their context and the way various forms of information (including biased information) were presented. The variability helps players to learn not to over-rely on one piece of information but to construct a general mental model about the biases and deception that considers as much of the information and cues as possible in relation to each other.

We embedded behavioral measures in all three of our games to assess short- and long-term effects and to identify progress during the learning process. Behavioral measures such as how many times the players performed a particular action, the sequence of their actions, and the duration of activities allowed us to track how players were interacting within the games and what choices they made. These data gave us a better understanding of which features were used more often and which were under-utilized. The behavioral data also allowed us to track player performance unobtrusively, to see if players were gradually improving during the training process, and to determine how long they spent in the game.

To assess the immediate and long-term effects of the games, we developed measurements of each bias based on previous literature. We administered the tests immediately after our study participants played the game and then again four to eight weeks later. As one of the goals was to measure transfer, the measurements were designed to be in a format that differed from the one used in the game. Thus, the players in MACBETH 2 learned how to avoid anchoring bias by considering alternative explanations and were prompted by the game to consider the possibility that the anchor was irrelevant to the target estimate. Meanwhile, for the post-game measures, and following experimental manipulations by Tversky and Kahneman (1974), we described an irrelevant number such as 'the tallest bridge in the United Kingdom suspends 2,431 feet above the ground' and asked participants to estimate how many candies there were in a picture of a candy jar (see Adame, 2016 for more details). In other words, the immediate and long-term measures did not share the same format as the training, enabling us to capture how well players can transfer the skills learned in the game to a similar context.

The third goal of our studies was to determine how the effects of the digital game training compared to traditional instructional videos. For the MACBETH studies, the comparison video was provided by the project's funding agency. The instructional video featured a series of short skits followed by an instructor figure explaining the types of bias displayed in them and providing tips on how to avoid them. This was produced independently from the design and content that we developed for our game. Although we were required by the funder to use the instructional video as a comparison group, we were concerned that the instructional content in the game and the video was not identical, which made it difficult to ascertain whether our results were due to differences in the medium (video vs. video game) or in the educational content. Nonetheless, even with this limitation, our results indicate the superiority of the long-term effects of a video game over an instructional video.

To increase correspondence between the game and the comparison group, we created our comparison videos in the MACBETH 2 and VERITAS projects from an animated PowerPoint lecture for the experiments. The instructional video content and de-biasing instructions were created to match the same content and instructions taught in the game. By comparing the game to an instructional video with similar training content, we were able to identify media features and mechanics that made video-game-based training more effective than an instructional video.

The final issue in need of resolution involved obviating the adverse psychological effects associated with resistance to training. As people are unaware of their own biases (Pronin, Lin, & Ross, 2002), convincing professionals they are just as susceptible to bias as everyone else requires careful message design to reduce their reactance to training while also motivating them to play the game. Our reasoning is grounded in *psychological reactance theory*, which posits that explicit persuasive messages can pose threats to the message recipients' perceived behavioral freedoms, resulting in reactance, wherein they seek to reestablish their autonomy by rejecting the message, derogating the source, and exhibiting behaviors in the direction opposite to those advocated (i.e., boomerang effects; Brehm & Brehm, 1981). We tested different levels of explicit (controlling) vs. implicit (autonomy-supportive) language within various aspects of the game to avoid reactance while also balancing the effectiveness of the games' instructions.

## Summary of findings

We conducted eight studies with more than 2,000 participants between 2013 and 2017 across four universities in the United States (University of Oklahoma, University of Arizona, University of California-Santa Barbara, and University of Florida). This summary describes the factors we examined and their effectiveness in increasing bias-relevant knowledge and bias mitigation.

### Feedback timing and source

One of the unique affordances of digital game-based learning is that digital games can provide feedback to players based on their performances. Many studies have examined the role of feedback in learning (e.g., Kluger & DeNisi, 1996; Goldberg & Cannon-Bowers, 2015; Shute, 2008; Hattie & Timperley, 2007). We assessed the effects of *feedback timing* (immediate vs. delayed) and *feedback source* (non-player character vs. other players) on bias knowledge and bias mitigation.

Studies have shown that while providing immediate feedback during game-play can increase its salience and allow players to adjust their decisions, it can also disrupt the game and break the flow (Attali & van der Kleij, 2017). As for the feedback source, studies have shown that explaining one's reasoning to someone else can reduce bias (Green, 1990); sometimes having other people question one's decision-making process can also make people more aware of their biases (Silverman, 1992).

We therefore designed two versions of MACBETH. In the single-player version, the players received feedback from computer-controlled non-player characters, whereas in the multi-player game, the players formed their judgments by working with another player and examining each other's proffered hypotheses. To our surprise, relative to the multi-player version, the single-player game in which players received feedback from a non-player (AI) character was significantly more effective at mitigating confirmation bias. This may be because playing with another player slowed down the pace of the game, and waiting for other players to respond interrupted the natural flow (see Dunbar et al., 2017, for more details). However, no significant differences between a single-player and a multi-player game were found for the knowledge or mitigation of fundamental attribution errors (Dunbar et al., 2017) or bias blind spots (Bessarabova et al., 2016).

One of our central hypotheses posited that providing players with immediate feedback would be more effective in mitigating bias and increasing knowledge about the issue than delayed feedback, presumably because immediate feedback enables players to think about their decisions right after they are made, allowing for immediate adjustments to their actions. However, there were no significant differences in bias mitigation between immediate versus delayed feedback (Dunbar et al., 2014; Bessarabova et al., 2016); in fact, our qualitative interviews suggested that some players found the immediate feedback annoying and perceived it as an interruption of their game-play.

### Repetition and duration

An intrinsically motivating digital game is likely to be played for a longer duration, engaging players in the training materials for extended periods of time. Digital games can also be played repeatedly, which is important for experiential learning, as it gives learners frequent opportunities to experiment with different choices and compare the outcomes of their decisions (Kolb & Kolb, 2005). We compared different durations (30 minutes vs. 60 minutes) of game-play and repetition (once vs. multiple times) for all of our studies involving cognitive biases.

Across our studies (with a few exceptions), we found that playing for a longer duration led to greater bias mitigation, more improved bias knowledge, and greater deception-detection skills. Repetition also significantly improved the effects of training. Increased duration and repetition had the effect of increasing exposure to the bias-related and deception-detection knowledge, providing players with more opportunities to practice their bias-mitigation and deception-detection skills. More importantly, repeated play is an essential requirement for a game-based training platform, given that learning game controls and often complex game mechanics is a prerequisite for engaging in the training; it is only after players learn to operate and navigate a game that cognitive resources can be freed up to focus on the training content presented (Lee & Heeter, 2017).

**Implicit vs. explicit training**

In comparison to classroom learning, which is often explicit in its presentation of material to learners, digital games can incorporate implicit instructions by demonstrating the interworking of a complex system through gameplay (Bogost, 2007; Ciavarro, Dobson, & Goodman, 2008). We created two versions of MACBETH to compare the differences between implicit and explicit video-game learning. In the explicit training condition, learning was attained through quizzes that appear throughout the game, testing players about their knowledge of biases. The implicit version did not have quizzes; instead, learning was embedded in the game mechanics and feedback.

Overall, our findings suggest that the implicit and explicit training conditions did not differ significantly in terms of effectiveness. However, the explicit training did increase bias knowledge (confirmation bias, bias blind spots, and fundamental attribution errors) immediately after playing the game, although these effects tended to fade over time (Dunbar et al., 2014).

**Instructional video comparison**

Interactive digital games have several advantages over traditional training videos. For the most part, the former allow players to actively make decisions and observe the immediate consequences of their actions, which is especially important when the training goal is to foster awareness of one's biases and modify decision-making processes accordingly. Video games can also provide a variety of simulated situations for players to practice their decision-making skills using multiple scenarios to promote skill transfer.

As mentioned above, in order to capture the differences between various educational methods, most of our experiments compared the effects of the game to an instructional video. Across the studies, we found our digital games were equally or more effective than the instructional videos in increasing bias knowledge and reducing biased decisions immediately after training. However, the effects of the instructional video quickly diminished, whereas the effects of the games did not, even after four to eight weeks. Players also reported higher enjoyment, motivation, and cognitive absorption while playing the games compared to watching instruction videos (Dunbar et al., 2014, 2017; Lee et al., 2016). The fact that the bias mitigation effects did not fade after eight weeks is remarkable, indicating that video games can be effective in the long term for decision-making training.

**Reactance to training**

When people feel like someone is trying to restrict their behavioral freedom or threaten their self-identity, they may react negatively and try to restore their threatened freedom (Brehm & Brehm, 1981). We compared the use of controlling language to autonomy-supportive language within our VERITAS experiments. Surprisingly, the manipulations did not appear to make a significant difference for the undergraduate student sample (Dunbar et al., 2018). However, the effects of reactance were more pronounced and significant for the law enforcement officer sample. The game-based training was more effective on police officers when the game used autonomy-supportive language within the instruction compared to more controlling language (Miller et al., 2018). One explanation for the difference between the students' responses and the law enforcement officers' responses may be because the latter group is not used to taking orders from university researchers. Another explanation is that, unlike police officers, students may not perceive themselves to be experts in detecting deception. In contrast, police officers may find their self-perceived authority threatened and could experience psychological reactance when the game explicitly instructs them to engage in deception training. If this is the case, they should be likely to respond more favorably toward autonomy-supportive instructions that frame the training as a way of improving their deception-detection skills.

## Conclusion

To persuade is to modify or reinforce people's attitudes, beliefs, and behaviors. Although training games are not always designed with persuasion in mind, we argue that most such games contain elements of social influence and persuasion. By offering players an opportunity to observe and examine their personal knowledge and skills, digital training games create the potential for *self-persuasion* (Zimbardo 1965; Bem, 1965; Aronson, 1999). In this way, digital games can expose gaps in one's understanding of a subject or skills within a non-threatening environment, thereby creating cognitive dissonance and uncertainty that can motivate players to investigate further, practice more, and improve their relevant skill sets. Such an approach might offer exceptionally strong motivation for professionals who may be overconfident in their ability to perform their work and thus undermotivated to receive further training. Studies have shown that role-playing and perspective-taking can be effective for self-persuasion because they encourage players to actively come up with arguments in support of certain positions. As such arguments are self-generated, the effects of self-persuasion may thus be stronger and longer-lasting (Zimbardo, 1965; Peng, Lee, & Heeter, 2010).

Our research shows that persuasive digital games offer an effective means for training bias mitigation, deception-detection, and improved decision-making. The interactive digital games that we tested consistently outperformed the more static instructional videos in terms of learning, enjoyment, motivation, and engagement. Of particular interest is the finding that the bias-mitigation effects of these serious digital games lasted longer than the comparison instructional videos. Informed by theories of psychology and social influence, the digital games reviewed here applied an iterative design approach that, through empirical evidence, helped to identify which methods were effective and which needed modification and improvement. Future persuasive game designs can benefit from this approach of incorporating theory into game design and using behavioral data and user feedback to improve the effects of the games.

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