The Gamification of Learning: Case Studies in Cognitive Bias and Deception Detection

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A brief history of deception research

- 1862, Duchenne de Bologne compares genuine smiles to fake smiles.
- Darwin includes these photos in his book *The Expression of Emotions in Man and Animals* in 1872. Brief discussion of deceptive emotional expressions spurs other scientists.
A brief history of deception research

- Ekman & Friesen offer the leakage hypothesis in 1969.
A brief history of deception research

Zuckerman, DePaulo & Rosenthal offer the first theory of deceptive behavior in 1981 known as “the four factor theory” in which they identify behavioral processes of deception:

- Attempted Control
- Arousal
- Affective Behavior
- Cognitive Load
A brief history of deception research

- Communication models begin to emerge that examine deception as a two-way communication rather than just examining deceiver behavior.
- Burgoon & Buller offer Interpersonal Deception Theory in 1996.
A brief history of deception research

- Research into nonverbal cues into deception explodes in the 1980s and 1990s
- Bond & DePaulo’s 2006 meta-analysis summarizes the findings. Other meta-analyses find similar results:
  - Average detection accuracy is only 54% across studies
  - Small studies have greater variation in accuracy rates
  - Stronger questioning methods can improve accuracy
“You can sense whether someone is retreating from you: They look away, they cross their arms, they’ll shift their focus, they will turn their body away,” she said. Also, pay attention to their eyes. “When I was interviewing Hillary Clinton, I knew when I’d ask her something that she wasn’t going to give me the complete truth because she would break eye contact with me.”
What do scientists know about deception today?

1. Lying is very difficult to detect (54%)
2. People are truth biased (other biases inhibit detection too)
3. Lying is fairly common but the average person is generally honest
4. Liars don’t feel guilty about lying
5. The face and the eyes do NOT give liars away
6. Verbal and linguistic cues are more reliable than nonverbal cues alone
7. Accusations do not reveal the truth
What do Police believe about liars?

(Vrij & Mann, 2005)

- 75% of Police think people look away when lying
- Nervousness often confused for deception
- Often taught the wrong cues in training manuals
- Inbau method (BAI) gives misinformation
- Police lack the truth bias lay people have
- Police accuracy ranges from 45-60%, about the same as lay people
Traditional training has failed
(Driskell, 2012; Hauch et al., 2014)

- Training only improves accuracy by 5%
  - Professionals have misplaced confidence, don’t think they need training.
  - People lack motivation to be trained effectively.
  - Telling people they are poor at something causes reactance.
  - Traditional focus on nonverbal cues which are faint and unreliable requires “mythbusting.”
  - Cognitive load makes the task too difficult, we rely on heuristics and bias.
Problem: Significant scientific knowledge not getting to the people who need it.
Why video games?

- Video games encourage...
  - Persistence
  - Problem solving
  - Cooperation
  - Critical thinking
  - Intrinsic motivation
  - Attentional skills
Video Games in Society

- The fastest growing form of entertainment.
- TWICE the revenue of the movie industry.
- Played by...
  - 97% percent of adolescents
  - 69% of all heads of households*
    - *Pew Internet & American Life Project
- Some surprising demographics...
  - One in four gamers is over 50
  - 81% of young adults (age 18-29) play games
  - 45% of all gamers are female
  - Average gamer is 35 w/12 years playing experience
Capitalizing on Video Games’ Best Features for Learning

- Games allow for repetition of lessons.
- Learners will play games voluntarily.
- Consider this...
  - “Reality is Broken” (McGonigal)
  - Virtuosos (Gladwell)
- Imagine if we could put that energy toward something benefiting their real everyday lives...
A real world problem

- Cognitive Biases
  - Natural tendency to use mental shortcuts called heuristics.
  - Cause us to avoid systematic thinking.
  - Enabled my memory, preferences, statistical flaws.
- Identified by IARPA as one of the major threats to the work of intelligence analysts.
- IARPA Sirius program designed to develop video game to mitigate cognitive bias.
- IARPA created a training video for us to beat.
First Game: MACBETH
Rapid Iterative Prototyping (RIP)
the game is played, evaluated, adjusted, and played again, allowing the design team to optimize adjustments to successive iterations or versions of the game.

From paper prototype to working game.

Playtests, focus groups with students, analysts, IARPA.

MACBETH went through more than 110 builds, dramatic changes over its first year of development.
Testing in 4 Experiments

Pilot Test
156 Students: More physiological engagement with game (Jensen et al., 2016, AIS Transactions on Human Computer Interaction)

Experiment 1:
Two Locations
703 Students Tested
Priming, 30 vs 60 min of play, and repetition of play
Winner: Priming in repeated play

Experiment 2:
Two Locations
620 Students Tested
Feedback, 30 vs 60 min of play, and repetition of play
Winner: JIT Feedback in repeated play

Experiment 3:
Two Locations
626 Students Tested
Single/Multi Player, 30 vs 60 min of play, and repetition of play
Winner: Single Player in repeated play
Key Results: Confirmation Bias
(Dunbar et al., 2014, Computers in Human Behavior)
Note: higher numbers indicate greater bias reduction.
Key Results: FAE Dispositions (Dunbar et al., 2014)
Note: higher numbers indicate greater bias.
Key Results: Bias Blind Spot
(Bessarabova et al. 2016, Computers in Human Behavior)
Note: higher numbers indicate greater bias.

Covariates appearing in the model are evaluated at the following values: Vertical Collectiv = 5.0160, Confirmation Proneness = 4.2591, extroversion = 4.5931, openness = 5.1286, conscientiousness = 5.4581, Horiz Indiv = 5.7546, Vertical Indiv = 4.7104.
Follow-up with MAC BETH 2
(Lee et al. 2016, Simulation and Gaming)
Sample results from MACBETH 2
(Note: Lower numbers = less bias)

- Combining the slideshow and the game together provides the best of both worlds:
  - Basic knowledge in a format students are used to
  - Game provides interest and motivation
  - Repetition of info

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What did we learn?

- Capitalize on games’ biggest assets...
  - repeat play, self-direction, immediate feedback on mistakes
- ...and they can be much more effective than traditional teaching methods.
- Even something as resistant to training as bias can be affected by effective game-based training.
- Rigorous scientific testing is necessary to control for other factors. Gamers differ from non-gamers in important ways and so random assignment is essential.
- Instructional methods can be combined for greater effect
A new training game: VERITAS

- Veracity
- Education and
- Reactance
- Instruction through
- Technology and
- Applied
- Skills

- Two scenarios: Job interview and a workplace theft
- Players ask questions, view video of the answers
- Try to detect deception, get feedback on errors
Steps in the Veritas game

- **Step 1**: Intro to the Game
- **Step 2**: Job Interview
- **Step 3**: Deception Instruction
- **Step 4**: Theft Interview

- Training based on scientific data in deception detection.
- Trained to look for CLUSTERS not CUES
Cluster 1: Tension

- Higher Pitch
- Pupil dilation
- Vocal tension
- Lip pressing
- Less smiling
Cluster 2: Uncertainty

- More ambivalent
- Less plausible
- Less involved and immediate
- Less embracement
- More negative statements
Cluster 3: Cognitive Load

- Pause longer
- Wait longer to answer
- Fewer illustrators
- Fewer hand/finger movements
- Fewer leg/foot movements
- More repetitions
- Shorter answers
Theories guiding us

- Heuristic-Systematic model (Chaiken, 1980)
  - Encourage systematic thinking, reduce reliance on biases

- Reactance Theory (Brehm, 1966)
  - Restricting freedom inhibits learning, causes arousal
  - Increasing autonomy, reducing threat will enhance learning

- Self-Affirmation Theory (Steele, 1988)
  - Affirming the self-image reduces defensiveness
  - Should be especially relevant if the training threatens self-image
Testing in 3 Experiments

Experiment 1:
510 students in 3 Locations
Manipulated reactance and self-affirmation
Compared to a traditional lecture

Experiment 2:
36 Law Enforcement Officers from 3 agencies
Manipulated reactance
Game only

Experiment 3:
191 students in 3 locations
Short version of game
Manipulated reactance
Compared to a traditional lecture
Experimental Design

- Test deception detection skill prior to playing VERITAS (pretest) and after playing VERITAS (posttest)
- Compare VERITAS to a traditional training delivered by PowerPoint
- Question: How to know when people improve? How to measure deception detection ability?
- Two methods:
  - Deception knowledge test
  - Deception skills test
Knowledge Test

- 10 multiple choice and true/false questions, randomly assigned 5
- Based on lecture/game content
- Sample question:
  
  “Spontaneous corrections happen when a speaker corrects his/her own mistakes while talking. They are used more by truth tellers than deceivers.”

  True or False?
Video Skills Test

- Cheating Study (Dunbar et al. 2015)
- 243 Undergraduate students at OU
- Encouraged to cheat by a confederate on a trivia game
- Interviewed afterward by expert examiners
- 8 videos selected
- 2 true, 2 lie in each test (4 total)
- I increased to 6 videos (Exp 3)
In-game metrics

- The game has 36 mandatory and 78 maximum interview questions that participants can ask to practice their deception detection skills. On average, users asked 53 questions each ($SD = 13$) with 12 users asking all 78 questions.

- Accuracy of assessments
- Accuracy of cues selected
- Confidence ratings
VERITAS Experiment 1 Results: Students

- No apparent effect for Reactance among student Sample
- Self-Affirmation made no difference
- Compared to the PPT lecture, VERITAS produced:
  - Greater Engagement
    - More enjoyment, perceived autonomy, perceived value.
    - More effort invested into the training
    - More enjoyment, focused immersion, feeling of control
Experiment 2 Results: Law Enforcement

- Compared to the pretest, VERITAS players...
  - Officers performed best in the LOW reactance condition during posttest.
  - Had significantly improved posttest performance in the TRUTH detection (but not Deception detection) video rating test.
  - Significantly improved scores on deception knowledge test.
  - Significantly improved from Scenario 1 to Scenario 2 for truth (80% -> 90%) and deception (59% -> 78%) detection.
The effect of VERITAS on Deception Detection Skill may be explained by the significant Time x Language interaction:

\[ F(4, 30) = 2.95, \ p = .036, \ \eta^2_p = .28 \]
Experiment 3 results: Short version of game with students

- **VERITAS players...**
  - Significantly improved from Scenario 1 to Scenario 2 for deception detection (56% → 65%)
  - Performed better than ppt (preliminary results).
Preliminary Conclusions on Effectiveness of VERITAS

- Low reactance version of the game is the most effective, although that mattered more for LEO than college students.
- People can learn the lessons relatively quickly. Improve 11-19% from first to second scenario in the game.
- People are more motivated and willing to learn in a game than a lecture.
- People learn the knowledge better in the game than the lecture and perform better in actual detection (especially when discerning TRUTH).
Challenges and Opportunities

- **Creating and testing games:**
  - Use a development team rather than try to piece together expertise.
  - Be careful in your recruitment materials: “Come play a video game for money” will bias your sample.
  - Have someone who can translate knowledge into content.
  - Focus groups and playtesting are essential steps.
  - Get feedback early from your target audience—consultants!
For copies of papers or questions...

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