CURRICULUM VITAE

Leonard D. Brown

Assistant Research Professor

Mel and Enid Zuckerman College of Public Health, University of Arizona

Contact Information

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Personal Statement

I am a multidisciplinary health sciences researcher with 20 years of experience in human-computer interaction, games, visualization, and augmented/virtual reality technology. On these topics, I have published more than a dozen scientific and technical papers and given over 30 invited talks and workshops nationally. I have also served as key personnel to procure and execute more than $3.5 million in competitive research grants and contracts, working with researchers from numerous departments within the University of Arizona and at six other national universities. For the last five years, I have been co-investigator for the Western Mining Safety and Health Training Resource Center, where I lead a team to develop new technologies for workforce training and assessment. Our computer-based serious games and other resources have been used by over two dozen companies and 12,000 mine workers to date. I have also taught a variety of courses at the collegiate level, including algorithms, computer graphics, data science, game development, and human-computer interaction. I have many years of experience in the full lifecycle of interaction design (usability engineering), particularly for health sciences applications. I hold a Ph.D. in Computer Science and completed a curriculum in entrepreneurship through the University of Arizona's McGuire Center for Entrepreneurship. A startup, Desert Saber, LLC, was launched through Tech Launch Arizona using intellectual properties from my dissertation.

Education

Doctor of Philosophy, Computer Science (Dec. 2015)

University: University of Arizona
Ph.D. Minor: Internal Specialization in Computer Graphics & Computer Vision
Dissertation: *Design, Evaluation, and Extension of Serious Games for Training in Mine Safety*
Committee: Hong Hua (Chair), Alon Efrat, Jerzy Rozenblit, Mary Poulton
Topics: Serious Games, Usability, Augmented Reality

New Venture Development Program (May 2017)

University: McGuire Center for Entrepreneurship, University of Arizona
Venture Project: *Desert Saber, LLC: Predict. Prevent. Evaluate.*
Press Release: https://uanews.arizona.edu/story/startup-licenses-ua-mining-safety-training-program

Bachelor of Science, Computer Science (Dec. 1999)
University: West Virginia University
Honors: *Summa Cum Laude* (3.898 GPA)
Capstone: *Virtual LitLand: A Virtual Environment Featuring Porte Crayon*
Topics: Virtual Reality in Humanities Computing

Honors & Scholarships

- Recognition for Teaching Excellence (Fall 2008)
  Department of Computer Science
  University of Arizona

- Presidential Scholarship (1995 – 1999)
  Award: Full Tuition Scholarship
  West Virginia University

Employment

Academic Positions

- Assistant Research Professor (Sept. 2020 – Present)
  Department of Community, Environment, and Policy
  Mel and Enid Zuckerman College of Public Health
  University of Arizona

- Instructor (Aug. 2019 – Present)
  School of Information
  College of Social & Behavioral Sciences
  University of Arizona

- Research Scientist (Jan. 2016 – Aug. 2020)
  Lowell Institute for Mineral Resources
  College of Sciences
  University of Arizona

- Communications Network Analyst, Sr. (Sept. 2014 – Dec. 2015)
  Lowell Institute for Mineral Resources
  College of Sciences
  University of Arizona

- Research Associate (Jan. 2010 – Aug. 2014)
  Department of Mining & Geological Engineering
  College of Engineering
  University of Arizona

- Teaching Assistant (Jan. 2007 – Dec. 2009)
  Department of Computer Science
  College of Sciences
  University of Arizona

- Research Assistant (Aug. 2004 – Dec. 2006)
  3DVIS Laboratory
  College of Optical Sciences
  University of Arizona

- Visiting Scholar (June 2003 – June 2004)
  3DVIS Laboratory
  Department of Information & Computer Science
  The University of Hawai'i at Manoa

- Research Assistant (Aug. 2000 – May 2003)
  Computer Vision & Robotics Laboratory
  Beckman Institute for Advanced Science & Technology
  The University of Illinois at Urbana-Champaign

- Undergraduate Research Assistant (Dec. 1998 – July 2000)
  Center for Literary Computing
  Department of English
  West Virginia University

Industry Positions

- Chief Operating Officer; Co-founder (Jan. 2017 – July 2019)
  Company: Desert Saber, LLC (Software start-up)
  Tucson, AZ, 85737
  Duties: Developed a scalable startup based on my university research (invention disclosures UA14-160 and UA17-245). Led commercialization efforts, including tech transfer process and development of business plan. Coordinated go-to-market strategy, value proposition and validation, financial strategy, and operations plan. Principal project manager and creative director for *PPE Suite*, serious games-focused health and safety management system for high risk industries. (Left company to focus on academic career.)

- Software Engineer, Game Development (April 2009 – March 2010)
  Company: Sony Corporation (Sony Online Entertainment - Tucson)
  Tucson, AZ, 85715
  Duties: Participated in the development of a Java/JOGL-based proprietary graphics engine; developed shaders in Cg; integrated SmartFoxServer backend with Facebook for casual gaming application; developed SQL queries for associated enterprise database. Titles developed included *Microforce Heroes* and *The Agency: Covert Ops* (Facebook).

- Software Engineer, Game Development (Jan. 2006 – Dec. 2006)
  Company: Octopi Game Labs, Inc.
  Tucson, AZ, 85715
  Duties: Developed graphical user interface capabilities; implemented rule sets and efficient graph algorithms for pawn movement on a hex-board; designed a framework of intelligent agents (i.e. "bots") for use in single-player campaigns. Titles developed included *PoxNora: Battlefield of the Immortals* and multiple expansion packs.

Government Positions

- Computer Specialist, Internship (April 1998 – Dec. 1998)
  Agency: National Institute for Occupational Safety & Health (NIOSH)
  Centers for Disease Control & Prevention (CDC)
  Morgantown, WV, 26505
  Duties: Supported agency research through systems administration of Sun Solaris and IBM mainframe computers, including job scheduling, data backup, batch file scripting, and Sybase database upkeep.

Teaching & Pedagogy

1. INFO 492, Directed Research (Instructor of Record)
   Department: School of Information, College of Social & Behavior Sciences
   University of Arizona
   Duties: Supervised undergraduate student research experiences in the design, development, and evaluation of serious games and apps for occupational health and safety training. Key points of emphasis included designing user experiences (UX) that augment learning through supportive gamification and scaffolding; applying technical skills, algorithms, and game development workflows to create and deploy mobile gaming apps on industry standard cloud platforms; and working with industry stakeholders to test and evaluate training effectiveness and postulate health and safety outcomes in the workforce.

2. 425/525, Algorithms for Games (Instructor of Record)
   Department: School of Information, College of Social & Behavior Sciences
   University of Arizona
   Duties: Developed undergraduate and graduate course sections covering the fundamentals of game logic and algorithms, including topics in high performance real-time graphics (e.g. shaders and render graphs), computer intelligence and agents, game physics, pathing, and collision detection; taught class sessions and facilitated weekly discussions; Designed and evaluated student examinations, homework assignments, and semester projects.

3. INFO 425/525, Algorithms for Games (Instructor of Record)
   Department: School of Information, College of Social & Behavior Sciences
   University of Arizona
   Duties: Developed undergraduate and graduate course sections covering the fundamentals of game logic and algorithms, including topics in high performance real-time graphics (e.g. shaders and render graphs), computer intelligence and agents, game physics, pathing, and collision detection; taught class sessions and facilitated weekly discussions; Designed and evaluated student examinations, homework assignments, and semester projects.

4. INFO 416/516, Introduction to Human Computer Interaction (Instructor of Record)
   Department: School of Information, College of Social & Behavior Sciences
   University of Arizona
   Duties: Developed undergraduate and graduate course sections covering the fundamentals of human computer interaction, including theory, practice, and assessment; taught class sessions and facilitated weekly discussions; Designed and evaluated student examinations, homework assignments, and semester projects.

5. INFO 696, Designing Usable Data (Instructor of Record)
   Department: School of Information, College of Social & Behavior Sciences
   University of Arizona
   Duties: Developed a PhD-level course exploring human factors in data visualization; Curated a list of scholarly readings, taught class sessions, and facilitated weekly discussions; Evaluated student presentations and critical response writing assignments.

6. GAMES 351, Introduction to Game Development (Instructor of Record)
   Department: School of Information, College of Social & Behavior Sciences
   University of Arizona
   Duties: Instructed undergraduate course sections covering the fundamentals of game design and development, including use of industry standard game engines and workflows, object-oriented design patterns, agile frameworks, and asset integration. Designed and taught modules and recitations around each learning objective. Provided practicum in Unity Game engine and C# programming language. Evaluated student examinations, homework assignments, and semester projects.

7. CS 433/533, Computer Graphics (Teaching Assistant)
   Department: Dept. of Computer Science, College of Science
   University of Arizona
   Duties: Taught class sessions and recitations; held office hours; developed course curriculum and assignments; performed course administration

8. CS 445, Introduction to Algorithms (Teaching Assistant)
   Department: Dept. of Computer Science, College of Science
   University of Arizona
   Duties: Taught recitations; held office hours; developed and graded assignments; performed course administration.

Publications

Book Chapters

1. Hua, Hong, **Leonard D. Brown**, & Rui Zhang. "Head-Mounted Projection Display Technology and Applications," *Handbook of Augmented Reality*, B. Furht (Ed.), New York: Springer, 123-155, 2011.

Refereed Journals

2. **Brown, Leonard D.**, Brianna Eiter, Ngan Pham, & Jefferey Burgess, "Toward a Systems Framework Coupling Safety Culture, Risk Perception, and Hazards Recognition for the Mining Industry," *Advances*

in Human Factors in Simulation and Modeling, Intelligent Systems & Computing series, Springer, 2022. (NIOSH invited paper.)

3. Wilson, Laurie, **Leonard D. Brown**, Rustin Reed, & Jefferey Burgess, "Gamification of Hazard Recognition in Mining with a Tabletop Card Game," *Advances in Human Factors in Simulation and Modeling*, Cassenti, D., Scataglini, S., Rajulu, S., & Wright, J. (Eds.), Intelligent Systems & Computing series, LNCS v. 1296, Springer, 2021. (NIOSH invited paper.)

4. **Brown, Leonard D.** & Mary M. Poulton. "Improving Safety Training through Gamification: An Analysis of Gaming Attributes and Design Prototypes," *Advances in Human Factors in Simulation and Modeling*, D. Cassenti (Ed.), Intelligent Systems & Computing series, LNCS v. 780, Springer, p. 392-403, 2019. (NIOSH invited paper.)

5. **Brown, Leonard D.** & Hong Hua. "Magic Lenses for Augmented Virtual Environments." *Computer Graphics & Applications*, vol. 26(4). IEEE Press, p. 64-73, 2006.

6. Hua, Hong & **Leonard D. Brown**. "System and Interface Framework for SCAPE as a Collaborative Infrastructure." *Presence: Teleoperators & Virtual Environments*, 13(2). MIT Press, p. 234-250, 2004.

7. Hua, Hong, **Leonard D. Brown**, & Chunyu Gao. "SCAPE: Supporting Stereoscopic Collaboration in Augmented and Projective Environments." *Computer Graphics & Applications*, 24(1). IEEE Press, p. 66-75, 2004.

8. **Brown, Leonard D.**, Hong Hua, & Chunyu Gao. "A Widget Framework for Augmented Interaction in SCAPE." *CHI Letters / Proceedings of UIST*, 5(2). ACM Press, p. 1-10, 2003.

Manuscripts in Progress

9. Reed, Rustin, **Leonard D. Brown**, and Jefferey L. Burgess. "Health and Safety Outcomes of Active Learning-based Mining Training Programs," *Mines, Metallurgy, and Exploration* (Submitted, Q1 2022).

10. **Brown, Leonard D.,** Michael Peltier, Mary Poulton, and Jefferey L. Burgess. "Synthetic Learning Environments for High Consequence Training in Mining Health and Safety," *Safety Science* (Submitted, Q1 2022).

11. **Brown, Leonard D.,** Mary Poulton, Jefferey L. Burgess, and Winslow Burleson. "Derivation and Analysis of an Enhanced Workflow for Safety Training using Synthetic Learning Environments," *Intl. Journal of Artificial Intelligence in Education* (Manuscript in Progress).

12. **Brown, Leonard D.**, Mary Poulton, and Jefferey L. Burgess. "Design Guidelines for Safety Training: A Contextual Inquiry Approach," *Intl. Journal Training & Development* (Manuscript in Progress).

Refereed Proceedings

13. **Brown, Leonard D.** & Hong Hua. "An Evaluation of Physical Affordances in Augmented Virtual Environments: Dataset Grounding and Magic Lens," *Proceedings of IEEE Virtual Reality* (*IEEE VR*). IEEE Press, Waltham, MA, p. 23-26, 2010.

14. **Brown, Leonard D.** & Hong Hua. "Toward a Tangible Interface for Multi-Modal Interior Design Using SCAPE." *Proceedings of IEEE Workshop on 3D User Interfaces: Beyond Wand & Glove-Based Interaction* (3DUI), IEEE Press, Chicago, p. 79-83, 2004.

15. Hua Hong, **Leonard D. Brown**, & Chunyu Gao. "A New Collaborative Infrastructure: SCAPE." *Proceedings of IEEE Virtual Reality* (*IEEE VR*). IEEE Press, Los Angeles, p. 171-179, 2003**. (Awarded Best Paper, Runner-up.)**

16. Hua, Hong, Chunyu Gao, & **Leonard D. Brown**. "A Testbed for Precise Registration, Natural Occlusion, and Interaction in an Augmented Environment Using Head-Mounted Projective Display." *Proceedings of IEEE Virtual Reality* (*IEEE VR*). IEEE Press, Orlando, FL, p. 81-89, 2002.

17. Hua, Hong, Chunyu Gao, **Leonard D. Brown**, Frank Biocca, & Jannick Rolland. "Design of an Ultralight Head-mounted Projective Display (HMPD) and Its Applications in Augmented Collaborative Environments." *Proceedings of International Society for Optical Engineering* (*SPIE*) v.4660, *Stereoscopic Displays and Virtual Reality Systems IX*, p. 492-497, May 24, 2002.

18. Hua, Hong, Chunyu Gao, **Leonard D. Brown**, & Jannick Rolland. "Using a Head-Mounted Projective Display in Interactive Augmented Environments." *Proceedings of International Symposium on Augmented Reality* (*ISAR*). IEEE Press, New York, p. 217-223, 2001.

Posters & Presentations

19. **Brown, Leonard D.**, Ngan Pham, Kelli McCormick, & Jefferey Burgess. "Small Mine Activities Reporting Tool: A Lightweight App to Improve Compliance Reporting and Track Outcomes." Health & Safety in Industrial Minerals & Aggregates Session, SME Annual Conference and Expo, Salt Lake City, UT, Feb. 27 - Mar 2, 2022.

20. Reed, Rustin, **Leonard D. Brown**, & Jefferey Burgess. ""Evaluation of Mine Safety and Health Training Programs Using a Pretest-Posttest-Control Design." Industrial Minerals & Aggregates & H&S Joint Session, SME Annual Conference and Expo, Salt Lake City, UT, Feb. 27 - Mar 2, 2022.

21. **Brown, Leonard D.** "Mobile Applications for Interactive Training and Performance Assessment," *Training Resources Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Nov. 2-4, 2021.

22. **Brown, Leonard D.**, Laurie Wilson, & Glenna Smith. "Learning Laboratories: An Outcomes-Focused Mentorship and Evaluation Program for the Health and Safety Trainer," *Training Resources Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Oct 14-15, 2020.

23. **Brown, Leonard D.** & Mary M. Poulton. "The Continuous Improvement Lifecycle: A Human Performance-based Safety Management System to Create Experts," Health & Safety Session on Safety Culture & Safety Management Systems, *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Phoenix, AZ, Feb. 23-26, 2020.

24. **Brown, Leonard D.**, Karen Noiva, Brenda Granillo, & Jeff Burgess. "Evaluating Mine Emergency Competency: Lessons Learned from Harry's Hard Choices," Health & Safety Session on Training Development and Assessment, *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Phoenix, AZ, Feb. 23-26, 2020.

25. Noiva, Karen, **Leonard D. Brown**, Rustin Reed, & Mary M. Poulton. "Evaluating Competency and Risk through Synthetic Learning Environments," *15th Annual Mine Safety and Health Conference*, Reno, NV, Oct. 21-23, 2019.

26. Wilson, Laurie & **Leonard D. Brown**. "Making Safety Personal: Resources for Training Curriculum Design and Assessment," *15th Annual Mine Safety and Health Conference*, Reno, NV, Oct. 21-23, 2019.

27. Noiva, Karen, **Leonard D. Brown**, & Mary M. Poulton. "Guidelines for Developing an Effective Safety Training Toolbox," *12th Annual New Mexico Mine Health and Safety Conference*, Albuquerque, NM, May 8-10, 2019. (Invited Talk)
28. Wilson, Laurie P., **Leonard D. Brown**, & Rose DiBona. "Measuring the Effects of Active Learning on Health and Safety Training," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 24-27, 2019.

29. **Brown, Leonard D.**, Brenda Granillo, & Mary M. Poulton. "Usage Paradigms for Synthetic Learning Environments: Strategies and Lessons Learned," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 24-27, 2019.

30. **Brown, Leonard D.** & Glenna Smith. "Participatory Design and Efficacy Testing of Serious Games," *Training Materials Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Oct 9-11, 2018.

31. **Brown, Leonard D.** & Mary M. Poulton. "Guidelines for Developing an Effective Safety Training Toolbox," *Training Materials Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Oct 9-11, 2018.

32. **Brown, Leonard D.** & Mary M. Poulton. "Usability Design Guidelines for Training in Mine Safety and Health," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Minneapolis, MN, Feb. 25-28, 2018.

33. **Brown, Leonard D.** & Brenda Granillo. "A Framework to Evaluate Safety Competencies Through Serious Games," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Minneapolis, MN, Feb. 25-28, 2018.

34. **Brown, Leonard D.**, Michael G. Peltier, & Mary M. Poulton. "*Learn with Harry:* Toward a Comprehensive Training Solution Using Serious Games," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Minneapolis, MN, Feb. 25-28, 2018.

35. **Brown, Leonard D.** "A Workflow for Mine Safety Training Using Serious Games: Design and Evaluation," *Training Materials Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Oct 10-12, 2017.

36. Poulton, Mary M. & **Leonard D. Brown**. "Improving Hazards Recognition and Situational Awareness Using Serious Games," *Training Materials Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Oct 10-12, 2017.

37. Granillo, Brenda & **Leonard D. Brown**. "Usage Paradigms for Serious Games: Strategies and Lessons Learned," *Training Materials Applied to Mining Annual Workshop* (*TRAM*), MSHA, Beaver, WV, Oct 10-12, 2017.

38. **Brown, Leonard D.** "Improving Hazards Recognition and Situational Awareness Using Serious Games," *MSHA Spring Thaw Training Workshop*, Rocky Mountain District, Scottsdale, AZ, May 5, 2017.

39. **Brown, Leonard D.**, Michael G. Peltier, & Mary M. Poulton. "Pre-Shift Inspection Training for Industrial Aggregates Using Serious Games," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 19-22, 2017.

40. **Brown, Leonard D.** & Mary M. Poulton. "A Workflow for Mine Safety Training Using Serious Games: Design and Evaluation," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 19-22, 2017.

41. **Brown, Leonard D.** "Using Serious Games for Training in Mine Safety," *MSHA Spring Thaw Training Workshop*, Rocky Mountain District, Scottsdale, AZ, May 6, 2016.

42. **Brown, Leonard D.** "MineSAFE: Application and Extension of Serious Games for Mine Safety Education," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Salt Lake City, UT, Feb. 23-26, 2014.

43. **Brown, Leonard D.**, John R. Hill, & Mary M. Poulton. "MineSAFE: A New Software Architecture for Mine Safety Education," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 24-27, 2013.

44. **Brown, Leonard D.** "Interactive Computer Games for Mine Safety." *8th Annual Western Region Mine Safety & Health Conference*, Reno, NV, Oct 22-24, 2012.

45. **Brown, Leonard D.**, John R. Hill, & Mary M. Poulton. "A Platform for Interactive Fatalgram Simulation Using Commodity Gaming Hardware." *7th Annual Western Region Mine Safety & Health Conference*, Las Vegas, NV, Oct 24-26, 2011.

46. Hua, Hong, **Leonard D. Brown**, Chunyu Gao, Narendra Ahuja, & Jannick Rolland. "A Head-Mounted Projective Display and its Applications in Interactive Augmented Environments." *ACM SIGGRAPH Technical Sketches and Applications*. ACM Press, Los Angeles, 2001.

Technical Reports

47. **Brown, Leonard D.** *Design, Evaluation, and Extension of Serious Games for Training in Mine Safety*. Ph.D. Dissertation, Dept. of Computer Science, University of Arizona, Tucson, AZ, 637 pgs, Dec. 2015.

48. Bachta, Edward, **Leonard D. Brown**, Nathan Carr, James Decker, Xin Jiao, William Nagel, Stephen Zelinka, & John Hart. "The Design and Implementation of a Programming Infrastructure for the Integration and Application of Implicit Surface Research." UIUCDCS-R-2001, Dept. of Computer Science, University of Illinois at Urbana-Champaign, Urbana, IL, 2001.

Visual Media

49. **Leonard D. Brown**. "*Harry's Hazardous Day*: Workplace Examinations Training," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 19-22, 2017. (Exhibit) Available at <https://www.youtube.com/watch?v=jj-h_b8BeuI>.

50. **Leonard D. Brown** & Steve Gravely. "Serious Games for Teaching Fatalgrams, Hazards Recognition, and Evacuation Drills." *Western Region Mine Safety & Health Conference*, Reno, NV, Oct 28-29, 2014. (Exhibit)

51. **Leonard D. Brown**. "*Harry's Hard Choices*: 101 Bad Outcomes," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Salt Lake City, UT, Feb. 23-26, 2014. (Exhibit) Available at <https://www.youtube.com/watch?v=2jaiC6fBaQI>.

52. **Leonard D. Brown**. "*Harry's Hard Choices* Interactive: A Gameplay Preview," *Society for Mining, Metallurgy, & Exploration Annual Conference* (*SME*), Denver, CO, Feb. 24-27, 2013. (Exhibit) Available at <https://www.youtube.com/watch?v=1OQg3a0clzo>.

53. **Leonard D. Brown**. "*Harry's Hard Choices*: An Interactive Game for Mine Emergency Preparedness," *8th Annual Western Region Mine Safety & Health Conference*, Reno, NV, Oct 22-24, 2012. (Exhibit) Available at <https://www.youtube.com/watch?v=1AEiUF0z2Xk>.

54. **Leonard D. Brown**. "Interactive Fatalgram Simulator: Video Demonstration," *7th Annual Western Region Mine Safety & Health Conference*, Las Vegas, NV, Oct 24-26, 2011. (Exhibit) Available at <https://www.youtube.com/watch?v=8BejF-7Cl2M>.

55. Hua, Hong, **Leonard D. Brown**, & Chunyu Gao. "SCAPE: A Collaborative Interface Showcase," *Video Proceedings of UIST*, ACM Press, Vancouver, CA, 2003.

56. Hua, Hong, **Leonard D. Brown**, & Chunyu Gao. "Head-Mounted Projective Display Technology Showcase: Augmented 'GO'," *Video Proceedings of IEEE Virtual Reality* (*IEEE VR*), IEEE Press, Orlando, FL, 2002.

Invention Disclosures & Patents

1. **Brown, Leonard D.**, Ngan Pham, Tuan Anh Bui, & Justin Felker. "Coming Home Alive: A Hybrid Mobile Gaming App for Health and Safety Training," University of Arizona (Disclosure Pending), 2022.

2. Peltier, Michael G. & **Leonard D. Brown**. "A Computer Simulation Platform incorporating Gamification and Human Performance Analytics for Training in Workplace Examinations, Hazards Recognition, and Hazards Mitigation," University of Arizona (Disclosure Pending), 2022.

3. **Brown, Leonard D.**, Ngan Pham, & Kelli McCormick. "Small Mine Activities Reporting Tool (SMART): A Mobile App to Improve Compliance Reporting and Track Outcomes," University of Arizona (UA22-013), 2021.

4. **Brown, Leonard D.**, Michael G. Peltier, & Mary M. Poulton. "Learn with Harry: A Serious Games Platform and Solution for Training in Mine Safety," University of Arizona (UA17-245), 2017.

5. **Brown, Leonard D.**, Michael G. Peltier, John R. M. Hill, & Mary M. Poulton. "MineSAFE: A Software Platform for Serious Games in Mine Safety Education," University of Arizona (UA14-160), 2014.

Participation in Grants & Contracts

1. National Institute for Occupational Safety & Health, "Western Mine Safety & Health Training Resource Center: Evidence-Based Learning Laboratories," Jefferey Burgess (PI)
   Award number: 2U60 OH010014-11-00
   Funding period: 9/2020 – 8/2023
   Funding amount: $1.458 million
   Role: Co-PI

Percent of effort: 90%
Duties: As co-PI for the Western Mine Safety & Health Training Resource Center, I co-lead the implementation of the Learning Laboratories approach and develop an industry trainer mentorship program to improve learning transfer and health and safety outcomes; lead a team of university researchers and consultants to design and develop new health and safety training strategies using "hybrid" gaming, which combines traditional and computer-based media, and interactive technologies for distance learning; develop and curate the UA Center's web portal, training analytics platform, and repository of training resources (at https://miningsh.arizona.edu); and implement efficacy assessments of new training methods and technologies.

2. Mine Safety & Health Administration, "Online Community Framework: Improving Evaluation of Training and Assessment of Health and Safety Outcomes for Contractors and Small Mine Operators," Leonard Brown (PI)
Award number: BS-37043-21-60-R-4
Funding period: 10/2021 – 9/2022
Funding amount: $140,000
Role: PI
Percent of effort: 20%
Duties: In this project, we extended our training resources with new materials that focus on accessible, app-based technologies to improve instruction and coordinate outcomes assessment for trainers serving contractors and small mine operators. The three aims of this project included the following: Aim 1: Provide app-based resources to enhance training for belt conveyor safety, electrical hazards, and accidents with powered haulage. Aim 2: Increase operators' capability to evaluate health and safety outcomes using a light weight, app-based reporting tool coupled with cloud-based tracking and assessment. Aim 3: Grow a supportive online community for contractors and small operators to share and discuss health and safety training materials, practices, and outcomes. I oversaw all specific aims and provide budgetary oversight of the program. I coordinated the project team, provided technical expertise, and supervised consultants across all Aims. I also worked with Learning Laboratories partners to implement training and assess training.

3. School of Mining and Mineral Resources, "Toward a Smarter Safety Management System using Data Analytics: A Multi-Factor Predictive Model to Improve Miner Health and Safety Outcomes," Leonard Brown (PI)
Award number: UArizona Seed Grant (Competitive Internal Award)
Funding period: 1/2022 – 6/2022
Funding amount: $53,768
Role: PI
Percent of effort: 15%
Duties: Analytical models and big data were used to evaluate the relationship between key leading indicators of health and safety (H&S) and their downstream lagging indicators. Lagging indicators were considered that include: 1) Eye injuries; 2) Hand injuries; 3) Sprains and strains of the ankle, knee, shoulder or back; and 4) Fractures and amputations. Using data provided by our industry partners, we employed machine learning (ML) methods to examine underlying relationships. This work included two phases: Phase 1 involved data collection and discovery of leading indicators using both exploratory and confirmatory statistical approaches. Phase 2 involved developing a proof of concept predictive model for each lagging indicator and assessing a variety of ML approaches. Classifier accuracy was evaluated against subject expert baselines as well as H&S outcomes. The leading indicators and

predictive technologies developed in this work will serve as a foundation to augment existing training programs and control hierarchies and develop proactive performance dashboards for next generation H&S management systems.

4. Mine Safety & Health Administration, "An Online Community Framework to Improve Instructional Design and Track Training Outcomes for Contractors and Small Mine Operators," Leonard Brown (PI)
   Award number: BS-35538-20-60-R-4
   Funding period: 10/2020 – 6/2022
   Funding amount: $100,000
   Role: PI
   Percent of effort: 10%
   Duties: This program developed a framework for on-demand access to training materials and instruction, coupled with cloud-based tracking and assessment, to augment the training capacity of contractors and small mine operators. The three specific aims of this project included the following: 1) Provide an online community repository of active learning resources with new materials for conveyor maintenance, powered haulage, and electrical hazards; 2) Enhance the instructional design and delivery capabilities of trainers through online tutorials and programs; and 3) Deploy a technology-enabled assessment framework to evaluate training competency and track worker safety and health outcomes. I oversaw all specific aims and provide budgetary oversight of the program and coordinate research activities between the University of Arizona and the South Dakota School of Mines and Technology. I assisted in the development of new training materials and technical components, conducted data collection and analysis, and evaluateed health and safety outcomes.

5. Mine Safety & Health Administration, "Evidence-based Training and Mentorship Program for Small and Medium Metal/Non-metal Mines," Eric Lutz (PI)
   Award number: BS-00501-19-60-R-4
   Funding period: 9/2019 – 3/2021
   Funding amount: $85,974
   Role: Co-PI
   Percent of effort: 10%
   Duties: Co-developed mentorship program for training materials deployment and assessment; led development of wrap-around materials and new content modules for computer-based serious game *Harry's Hazardous Day* and integration of external computing learning resources including NIOSH Examiner into training packages and data collection framework. Served as de jure principal investigator while PI was on active duty due to COVID-19 pandemic.

6. National Institute for Occupational Safety & Health, “Western Mine Safety & Health Training Resource Center: An Integrated Approach,” Jefferey Burgess (PI)
   Award number: 2U60 OH010014-08
   Funding period: 9/2017 – 8/2020
   Funding amount: $1.44 million
   Role: Co-PI
   Percent of effort: 90%
   Duties: As co-PI for the Western Mine Safety & Health Training Resource Center, I ensured the successful execution of project aims and the fulfillment of research objectives; led a team of university researchers and consultants to design and evaluate new training strategies for health and safety centering on synthetic learning environments using pervasive gamification, high immersion, and stealth evaluation; and worked with industry and academic partners to identify strategic training needs, implement

new technologies in practice, conduct workshops, and improve health and safety training industry-wide.

7. Mine Safety & Health Administration, "Integrated Preparedness Training Program to Improve Emergency Self-Escape of Underground Miners," Brenda Granillo (PI)
   Award number: BS-29782-16-60-R-4
   Funding period: 9/2016 – 6/2018
   Funding amount: $187,054
   Role: Co-PI
   Percent of effort: 25%
   Duties: Developed a conceptual model for an integrated training program which encompasses the full spectrum of the preparedness cycle (plan, organize/equip, train, exercise, and evaluate/improve); evaluated the effectiveness of emergency preparedness training by incorporating the serious game *Harry's Hard Choices* as the intermediate step between training and mandatory quarterly evacuation drills.

8. National Institute for Occupational Safety & Health, "Western Mine Safety & Health Training Resource Center: Translating Training to Competency," Mary Poulton (PI)
   Award number: 3U60 OH010014-05S1
   Funding period: 9/2014 – 8/2017
   Funding amount: $1.36 million
   Role: Research scientist (Tech Lead)
   Percent of effort: 70%
   Duties: Project team leader for second generation MineSAFE platform and new gaming initiatives for hazards recognition and emergency prevention; supervised a team of 5 developers, including UA staff, students and contractors; managed team resources and made budgetary decisions explored applications of emerging user interface and display technologies for training with serious games; conducted multiple user studies of serious game prototypes.

9. Mine Safety & Health Administration, "Improving Emergency Self-Escape of Underground Miners via Competencies, Experiential Learning, and Virtual Reality Gaming," Brenda Granillo (PI)
   Award number: BS-27763-15-60-R-4
   Funding period: 9/2015 – 3/2017
   Funding amount: $167,000
   Role: Research scientist (Tech Lead)
   Percent of effort: 30%
   Duties: Developed a post-game dashboard and analysis tools for *Harry's Hard Choices*, a serious game for mine emergency preparedness; participated in the development of a competency model aligned with the game framework and efficacy testing with industry partners.

10. Mine Safety & Health Administration, "Improving Miner Preparedness and In-emergency Resiliency Using Multi-Player Mine Emergency Response Simulations," Mary Poulton (PI)
    Award number: BS-26353-14-60-R-4
    Funding period: 9/2014 – 3/2016
    Funding amount: $137,000
    Role: Research scientist (Tech Lead)
    Percent of effort: 30%
    Duties: Developed a multi-player proof of concept capabilities for *Harry's Hard Choices*, a serious game for mine emergency preparedness; designed and conducted usability tests of single player game at multiple test sites.

11. National Institute for Occupational Safety & Health, "Western Mine Safety & Health Training Resource Center," Mary Poulton (PI)
    Award number: 1U60 OH010014-01
    Funding period: 9/2010 – 8/2014
    Funding amount: $1.25 million
    Role: Research associate (Graduate)
    Percent of effort: 60%
    Duties: Served as project team leader for MineSAFE, a software platform to create low-cost "serious games" for new miner and refresher courses; supervised a team of 10 developers, including UA staff, students and contractors; managed team resources and made budgetary decisions; led development of game prototypes to illustrate platform capabilities for fatalgrams and hazards recognition.

12. Mine Safety & Health Administration, Brookwood Sago Award, "Testing and Evaluation of Computer Software Simulations for Mine Emergency Preparedness," Mary Poulton (PI)
    Award number: BS-23833-12-60-R-4
    Funding period: 9/2012 – 8/2013
    Funding amount: $167,000
    Role: Research associate (Graduate)
    Percent of effort: 50%
    Duties: Conducted preliminary usability evaluation of the serious game *Harry's Hard Choices* with end users; developed new gaming capabilities based on user feedback.

13. Mine Safety & Health Administration, Brookwood Sago Award, "Improving Mine Emergency Prevention Using Computer Software Simulations," Mary Poulton (PI)
    Award number: BS-22468-11-60-R-4
    Funding period: 9/2011 – 8/2012
    Funding amount: $122,000
    Role: Research associate (Graduate)
    Percent of effort: 50%
    Duties: Game producer for *Harry's Hard Choices*, a game for mine emergency preparedness; supervised a team of 6 developers, including UA staff, students and contractors; managed team resources and made budgetary decisions; my technical contributions included development of the game design document, game mechanics, user interface, adaptive dialog framework, and game extensions for virtual reality.

14. Science Foundation Arizona, "Sustainable Development of Critical Earth Materials," Mary Poulton (PI)
    Award number: SRG 0330-08
    Funding period: 1/2009 – 12/2012
    Funding amount: $8.7 million
    Role: Research associate (Graduate)
    Percent of effort: 50%
    Duties: Conducted field studies of industry training needs and deficiencies; developed proof-of-concept demonstrations for computer gaming-based training methods.

15. National Science Foundation / Information & Intelligent Systems, "CAREER: Development of a heterogeneous display environment to support complex data visualization," Hong Hua (PI)
    Award number: 06-4446
    Funding period: 9/2007 – 8/2012
    Funding amount: $500,000
    Role: Research assistant (Graduate)

Percent of effort: 50%
Duties: Assisted in design and development of a proprietary hybrid display environment incorporating high-resolution 2D touch surfaces and stereoscopic 3D displays; co-developed freehand gesture-based interaction capabilities and vision-based hand and fiducial tracking system; created proof-of-concept applications to demonstrate hybrid interface technologies.

16. National Science Foundation / Information & Intelligent Systems, "Development and assessment of a polarized head-mounted projective display technology," Hong Hua (PI)
    Award number: 05-34777
    Funding period: 9/2005 – 8/2008
    Funding amount: $310,000
    Role: Research assistant (Graduate)
    Percent of effort: 50%
    Duties: Developed and tested new user interfaces and visualization methodologies for proprietary augmented virtual environment called SCAPE; developed a set of information complexity management techniques using coordinated multi-scale visualizations and Magic Lens methods.

17. National Science Foundation / Information & Intelligent Systems, "Development of a head-mounted projective display for distance collaborative environments," Hong Hua (PI)
    Award number: 00-83037
    Funding period: 9/2000 – 8/2004
    Funding amount: $294,000
    Role: Research assistant (Graduate)
    Percent of effort: 50%
    Duties: Developed software infrastructure and interactive techniques for a proprietary augmented virtual environment called SCAPE; created a toolset of augmented Tangible User Interfaces, using passive haptic props of various form factors.

Professional Service & Outreach

- Co-Coordinator, Western Mining Safety & Health Training Resource Center (2017-Present)

Reviewer: A*CM Symposium on User Interface Software & Technology* (2005, 2008, 2009)
IEEE International Symposium on Mixed & Augmented Reality (2003-2014)
IEEE Virtual Reality (2012, 2013, 2016)
IEEE Virtual Reality Software & Technology (2010, 2014, 2015)

- Advisor & mentor, NSF Research Experiences for Undergraduates (REU) (2009, 2014)

Society Memberships

- Association for Computing Machinery (ACM)
- Institute for Electrical & Electronics Engineers (IEEE)
- Phi Kappa Phi (National Honor Society)
- Upsilon Pi Epsilon (Computer Science Honorary)

Technical Proficiencies

- Programming Languages: C/C++, Java, Matlab, Python, R, Scheme/LISP, SQL, GLSL, HLSL
- APIs and Frameworks: DirectX, OpenGL, OpenCV, R Studio, SAS, Matlab
- Development Platforms: Eclipse, Visual Studio .NET, Unreal, Unity, Drupal
- Management Tools: Agile methods, Jira, Microsoft Project, Scrum, Slack, Subversion, Git

Technical Courses Completed

Computer Science & Engineering, Undergraduate (West Virginia University)

1. Fundamentals of Computer Science (CS 15)
2. Data Structures (CS 16)
3. Systems Programming & Unix (CS 56)
4. File Structures (CS 76)
5. Introduction to Algorithms (CS 126)
6. Principles of Programming Languages (CS 136)
7. Principles of Software Engineering (CS 176)
8. Object-Oriented Design in C++ (ECE 210)
9. Principles of Operating Systems (CS 256)
10. Computer Architecture (CS 266)
11. Introduction to Artificial Intelligence (CS 286)

Mathematics, Undergraduate (West Virginia University)

12. Calculus 1 (Math15)
13. Calculus 2 (Math16)
14. Discrete Mathematics (Math 26)
15. Formal & Symbolic Logic (Phil10)
16. Statistics & Probability for Engineers (Stat 201)
17. Numerical Methods (Math 220)
18. Linear Algebra (Math 237)

Computer Science & Engineering, Graduate (University of Illinois)

19. Computer Graphics (CS 318)
20. Computer Architectures & Optimization (CS 333)
21. Adv. Topics (Graphics): Mathematical Modeling of Surfaces (CS 497)
22. Adv. Topics (Graphics): Photorealistic Rendering (CS 497)
23. Adv. Topics (Graphics): Real-time Rendering (CS 497)

Computer Science & Engineering, Graduate (University of Arizona)

24. Principles of Programming Languages (CS 520)
25. Computer Networking (CS 525)
26. Digital Image Processing (ECE 532)
27. Analysis of Algorithms (CS 545)

28. Advanced Operating Systems (CS 552)
29. Compilers & Optimization (CS 553)
30. Computer Vision (CS 577)
31. Adv. Topics (Algorithms): Machine Learning (CS 645)

Business Management, Graduate (University of Arizona)

32. Industry Analysis & New Venture Development (ECON 534)
33. New Venture Finance (FIN 536)
34. Planning of New Ventures (MGMT 539)

Teaching Philosophy

My teaching philosophy derives from more than 10 years of field experience in workforce training and academic instruction. My teaching methods largely conform to Constructivist theories of learning, which postulate that learning is largely exploratory and self-motivated within each student's zone of proximal development. Concepts are not transmitted, but rather constructed willingly by the student. For learning to occur, concepts must be 1) grounded in a *context* that sparks intellectual curiosity and 2) facilitated through *challenges and opportunities* for creative and analytical thinking. From a practical standpoint, this teaching philosophy requires a high degree of empathy toward students' individual needs and an emphasis on open-ended problem-solving as a primary vehicle of learning and assessment.

Although my courses stress a rigorous theoretical core, I also emphasize critical context through applications and examples that are relevant to current social, economic, and technological challenges. Course topics are aligned with other disciplines and used to solve real-world problems in those disciplines. To the extent possible, I try to align examples with the professional interests and studies (e.g. majors) my students. I have a strong interdisciplinary background that coalesces 20 years of academic, industry, and entrepreneurial experience, and I have often found that my own experiences (both good and bad!) serve as useful teaching points to provide perspective and evoke critical discussion.

The corpus of research on andragogy suggests that active learning methods increase student engagement and provide new challenges and opportunities for learning; I find these methods to be fundamental in educating the post-millennial generation, which is neither content with nor attentive to classical methods of instruction. I routinely employ group-based activities, discussions, and recitations to supplement the necessary didactic (e.g. lecture-driven) components of my courses. I have also found these practices to be extremely useful during the coronavirus pandemic. Furthermore, I develop learning materials and assessments around *synthesis and application* rather than memorization and recall. Through flexible projects and homework, I encourage students to apply course concepts to their own interests and bases of knowledge and to come up with novel solutions to problems that excite them. I also frequently provide options for students (both graduate and undergraduate) to work on projects relating to my and colleagues' funded research initiatives.

In terms of my collegiate teaching experience, I have served as an Adjunct Instructor for the School of Information since 2019. In this capacity, I have prepared and executed several courses, including Introduction to Human-Computer Interaction (ISTA 416 / INFO 516), Algorithms for Games (ISTA 425 / INFO 525), and Designing Usable Data (INFO 696). The new INFO 696 seminar explores human factors in data science and information visualization. Formerly I served as a Teaching Assistant (TA) for Computer Science courses that included Computer Graphics (CS 433/533) and Analysis of Algorithms (CS445). I taught these courses on

multiple occasions under supervision of CS faculty (Drs. Kobus Barnard and Elon Efrat). My Teacher-Course Evaluations (TCEs) have been consistently excellent; samples of recent TCEs are available upon request.

I also teach a variety of short courses and workshops for professionals in the mining industry. This is an initiative of the Western Mining Safety and Health Training Resource Center, for which I serve as Co-Director. My Center has trained over 12,000 industry workers to date. In support of these efforts, I developed a technical framework that uses games and computer-based active learning to assess worker competency, characterize performance, and quantify outcomes in line with Levels 2 (Learning), 3 (Behavior), and 4 (Outcomes), respectively, of Kirkpatrick's Evaluation Model (1994). This NIOSH-funded project is on-going and largely derives from my dissertation work on effective training technologies for workforce health and safety.

Professional References

1. Jeff Burgess, M.D., MPH, Associate Dean for Research, College of Public Health, University of Arizona

   Email: jburgess@arizona.edu
   Tel: (520) 762-4918
   History: Dean Burgess is principal investigator for the UA's Western Mine Safety and Health Training Resources Center (WMTC). Over the last 3 years, I have worked closely with Dr. Burgess in my role as Co-PI for training technology development and coordinator of the WMTC.

2. Mary M. Poulton, Ph.D., Professor Emerita, Mining & Geological Engineering, University of Arizona

   Email: mpoulton@arizona.edu
   Tel: (520) 603-0210
   History: Prof. Poulton is a former supervisor and Ph.D. committee member. Until her retirement, she was head of the Lowell Institute for Mineral Resources and longtime Chair of the Dept. of Mining & Geological Engineering. She co-supervised my research for nine years.

3. Hong Hua, Ph.D., Professor, College of Optical Sciences, University of Arizona

   Email: hhua@optics.arizona.edu
   Tel: (520) 626-8703
   History: Prof. Hua served as Chair of my Ph.D. committee and holds a joint appointment with the Dept. of Computer Science. I conducted research in her 3DVIS laboratory (3D Visualization & Imaging Systems), on various topics in Augmented Reality, including interfaces, visualization, and computer vision, co-authoring numerous papers on these subjects.

4. Catherine Brooks, Ph.D., Director & Associate Professor, School of Information, University of Arizona

   Email: cfbrooks@arizona.edu
   Tel: (520) 621-3565
   History: Prof. Brooks serves as Director for the School of Information (iSchool). She is the supervisor for my instructional duties in the iSchool, through which I teach technical courses on human-computer interaction, data science, and game development.

5. Hong Cui, Ph.D., Professor, School of Information, University of Arizona

   Email: hongcui@arizona.edu
   Tel: (520) 621-3565

History: Prof. Cui and I are collaborating on a grant proposal related to heterogeneous data integration and predictive analytics for workplace health and safety. We recently submitted a research proposal on this topic to the Alpha Foundation (pending review) and are continuing exploratory work toward an NIH proposal (R01) later in 2021.

6. James Jindrick, Director of Corporate Engagement (Retired), Office of Research, University of Arizona

Email: jindrick@arizona.edu
Tel: (520) 762-4620
History: Mr. Jindrick is former longtime mentor and instructor for the McGuire Center for Entrepreneurship with substantial technology industry experience. He served as my advisor and mentor through the entrepreneurship program and in post-graduate start-up development.