USC Institute for Creative Technologies Report | 17 August

USC ICT Update on DoD's Newest Learning Technologies

Keith Brawner, Ph.D.
USC ICT

William Swartout
USC ICT and USC Viterbi School of Engineering

Arno Hartholt
USC ICT

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Tim Welch
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iFEST
#ADLiFEST

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – SOLDIER CENTER

PM ICT Overview Briefing

Dr. Keith Brawner
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Controlled By: DEVCOM SC
Controlled by: SED
Category: OPSEC
Dissemination Control: FEDCON
POC: Joe Lisella 407-208-3435

ICT 6.2* PROGRAM MANAGERS

- **Dr. Keith Brawner –**
  Present Incumbent 14 March 2022

- **Dr. John Hart –**
  Retired 28 February 2022

April 2008

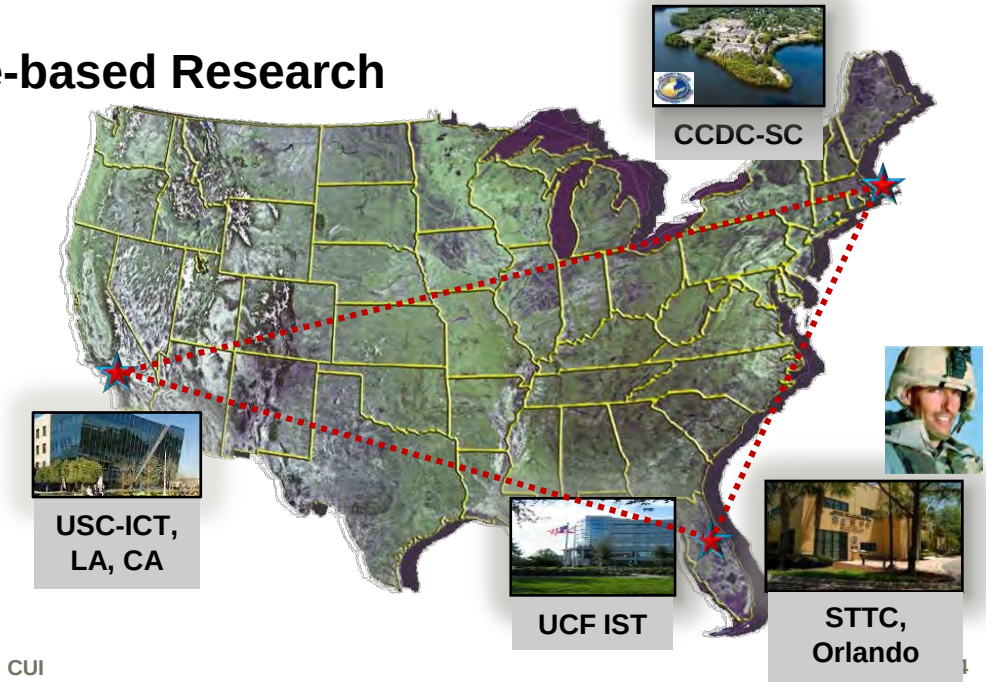
(except)

- **Colonel Harry Buhl –**
  Retired 31 October 2018

(during Mr. Hart's 12 month sabbatical)

ICT CORE COMPETENCIES
(CONTRACTUAL)

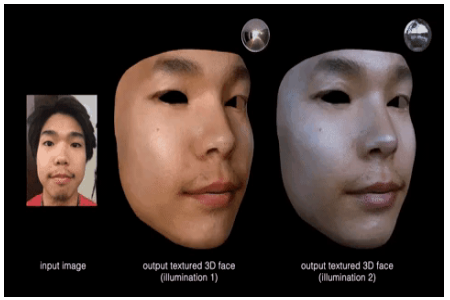
- **Generation and display of Realistic Sensory input for immersive virtual environments**
- **Development of Engaging Virtual Simulation, video-based training, and medical / health content**
- **AI computer-based Individual / Group Models and Behaviors**
- **Learning theory, design, and assessment for Effective Instructional Content**
- **Knowledge integration and purpose-based Research**



HISTORY AND ACHIEVEMENTS

- Established 1999 in Playa Vista, CA by USD (R&E)
- Historical Alignment – STRICOM, RDECOM, ARLHRED
- Present Day – DEVCOM Soldier Center, Simulation and Engineering Directorate (SED), Orlando, FL

- Technical Achievements – Virtual Humans, Natural Language Processing, Facial / Gesture Recreation from Humans, Artificial Intelligence / Machine Learning, Virtual Reality, and Mixed Reality



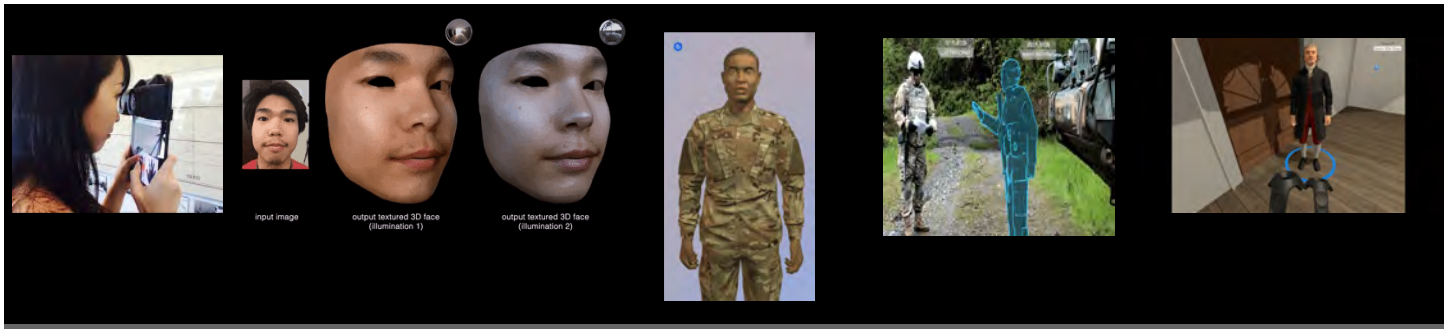
- Application Achievements –

  > Combat Training Sims - BiLAT, UrbanSim, MCIT, DisasterSim

  > Today = Army STE for MDO, Army SHARP Trainers
  OWT, TSS, TMT, etc.

MISSION STATEMENT AND BACKGROUND

Simulations so compelling, people respond as if they are real



Mixed Reality | Vision & Graphics | AI / Virtual Humans | Simulation | Learning Sciences

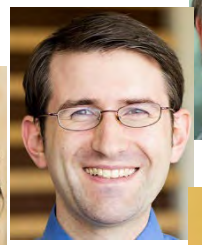
Mission

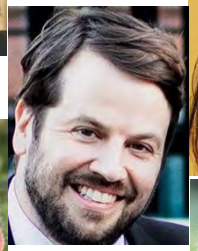
Create immersive experiences leveraging cutting-edge technologies, basic and applied research, the art of entertainment, and storytelling to simulate the human experience to benefit learning, education, health, human performance knowledge.

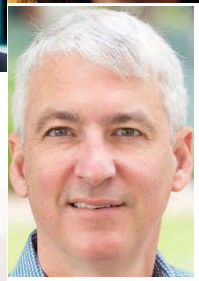
–Est. 1999 in LA –Targets: Training, Education, Terrain, Multi Domain Operations (MDO), Cross-Domain Maneuver (Tactical), Medicine, & SHARP	–CCDC Soldier Center STTC is **DoD Sponsor / UARC Program** Manager under Army Futures Command (AFC)	–One of the **4** Army sponsored University Affiliated Research Centers (UARCs)	**Unique core competencies** (AI, learning sciences, psychology, medicine, industrial design, digital arts, computer graphics, VR/AR)	Partnership between the **Army / DoD, Hollywood, and Academia**	**RIDE**: Virtual Environment for Research / Acquisition Communities to Evaluate Models

KEY PRINCIPLE INVESTIGATORS & RESEARCH AREAS

- **Body Computing & Human Performance – *Dr. Leslie Saxon, MD***
- **Affective Computing & Intelligent Interactive Agents – *Jonathan Gratch***
- **Learning Sciences – *Ben Nye***
- **Medical Virtual Reality (VR) – *“Skip” Rizzo***
- **Mixed Reality (MR) – *Jessica Brillhart***
- **Modeling & Simulation (M&S) – *Kyle McCullough***
- **Dialog Group – *David Traum***
- **Narrative Group – *Andrew Gordon***
- **Vision & Graphics Lab – *Research Lead: TBA***
- **Research and Development Integration – *Arno Hartholt***
- **Social Simulation – *David Pynadath***
- **Cognitive Architecture – *Volkan Ustun***







MISSION RDT&E RESEARCH PROJECTS

- **Currently For New FY 2022-24 Starts**

- **Presented to the Army's Technical Advisory Board (TAB)**
  - **> Individual Principle Investigators Conduct Presentations**

- **TAB Membership –**
  - **> Mr. Jeffery Singleton, Director of Technology, HQDA ASA(ALT)**
  - **> Mr. Douglas Tamilio, Director, DEVCOM Soldier Center**
  - **> Dr. Patrick Baker, Director, DEVCOM ARL**
  - **> Mr. John Willison, Deputy to Commanding General, DEVCOM**
  - **> Mr. Doug Matty, AI2C**
  - **> BG William Glaser, Director, STE CFT**
  - **> BG Charles Lombardo, CG, CAC-T, TRADOC**
  - **> Ms. Karen Saunders, Director, PEO STRI**

- **TAB Approves Nominated Projects**
  - **> Nine Approved in 2022 Virtual TAB Meeting**
  - **> Format is One Page Quad Per Nomination on Following Slides**

CUSTOMER FUNDED PROJECTS

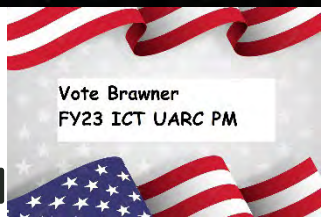
- ARMY SHARP – DIGITAL INTERACTIVE VICTUM INTAKE SIMULATOR (DIVIS)
- NAVY PERSONAL ASSISTANT FOR LIFE LONG LEARNING (PAL3) SIMULATION
- AIR FORCE SHARP TRAINER
- FLEET WRITERS ROOM: VISION 2041 / IMMERSIVE COMMAND CENTER
- ARMY KINGSMAN – ADVANCED ARMY LEADERSHIP TELEPRESENCE
- WARGAMING COALITION SIMULATION PLATFORM
- VISUAL ABSTRACTION FOR SYNTHETIC TRAINING (VAST)
- MODERNIZING TERRAIN PROGRAM
- BORDER SECURITY (EXBS) EGYPT NPS PROJECT
- MARL LEARNING TRANSFERABLE HIERARCHICAL POLICES IN MULTI-AGENT REINFORCEMENT LEARNING
- STE: OWT DATA MODELS, VIRTUAL ROLE PLAYERS, & TSS ARCHITECTURE

MISSION RDTE FUNDING – 6.1, 6.2, & 6.3

- **RDT&E 6.1:**
  - > ~$6M each Fiscal Year
  - > CRADA
  - > ARO (ARL) Executes Funds

- **RDT&E 6.2:**
  - > ~$5M each Fiscal Year
  - > PM ICT, DEVCOM SC Managed
  - > Sole Sourced 5-Year Contract

- **RDT&E 6.3:**
  - > $4+M each Fiscal Year, <u>will be closer to $10M FY23</u>
    Vote Brawner for permanent PM
  - > ICT Proposes Projects and external S&T Managers Approve
  - > Unique contract means <u>work starts very quickly</u>



- REALISTIC
  - Generation and display of realistic sensory input for immersive virtual environments
- VIRTUALIZED
  - Development of engaging virtual simulation, video-based training, and medical/health related content
- COMPUTERIZED and BEHAVIORALIZED
  - Use artificial intelligence technologies to generate computer-based individual & group models/behaviors
- EFFECTIVE
  - Study and develop applications of learning theory, instructional design, and assessment to create effective instructional content
- CROSS-CUTTING
  - Conduct knowledge integration and purpose-based research from core research disciplines in support of training, education, operations, mental/physical health

HOW CAN PM ICT HELP?

- What are your Needs?
- What are your Issues?
- Do you Need a Prototype?
- Do you Need Information Transitions?
- Do you Need an Independent Technical Assessment?
- Do you Need a Technology Solution?
- Do you Need a Virtual Environment to Conduct Research, Development, Experiments, Testing, Prototyping?
- Do you Need RIDE? VHtK

ICT has a special Government relationship, in two parts:

1 – Mission Projects exist for the Army's needs

2 – There is a flexible contract (30 days, minimal passthrough) for non-mission projects

Newsletters up front! Sign up!

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A University Affiliated Research Center

PAL3: A Framework for Personalized Learning

Bill Swartout
Chief Technology Officer, ICT

Ben Nye
Director of Learning Science Research

The work depicted here was sponsored by the US Navy N1/N17, ONR, NDEP and MOM RP. Statements and opinions expressed do not necessarily reflect the position or the policy of the United States Government, and no official endorsement should be inferred.

PAL3 Project Goals

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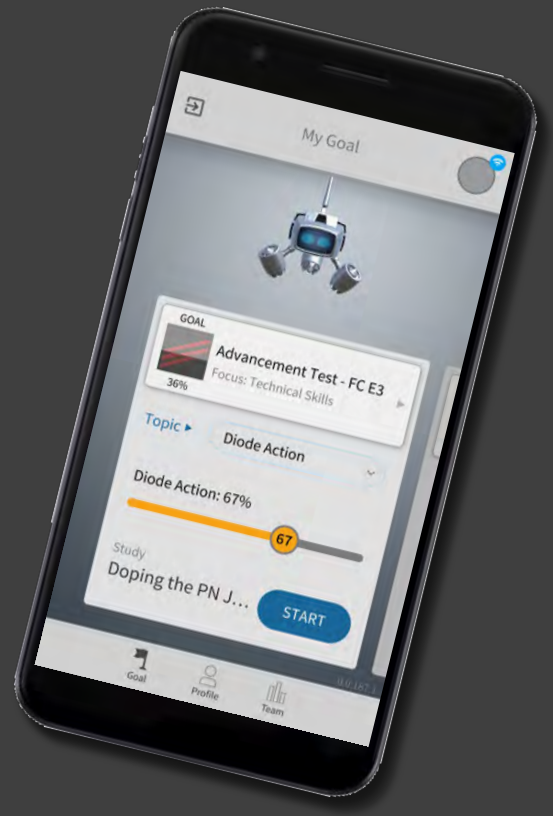
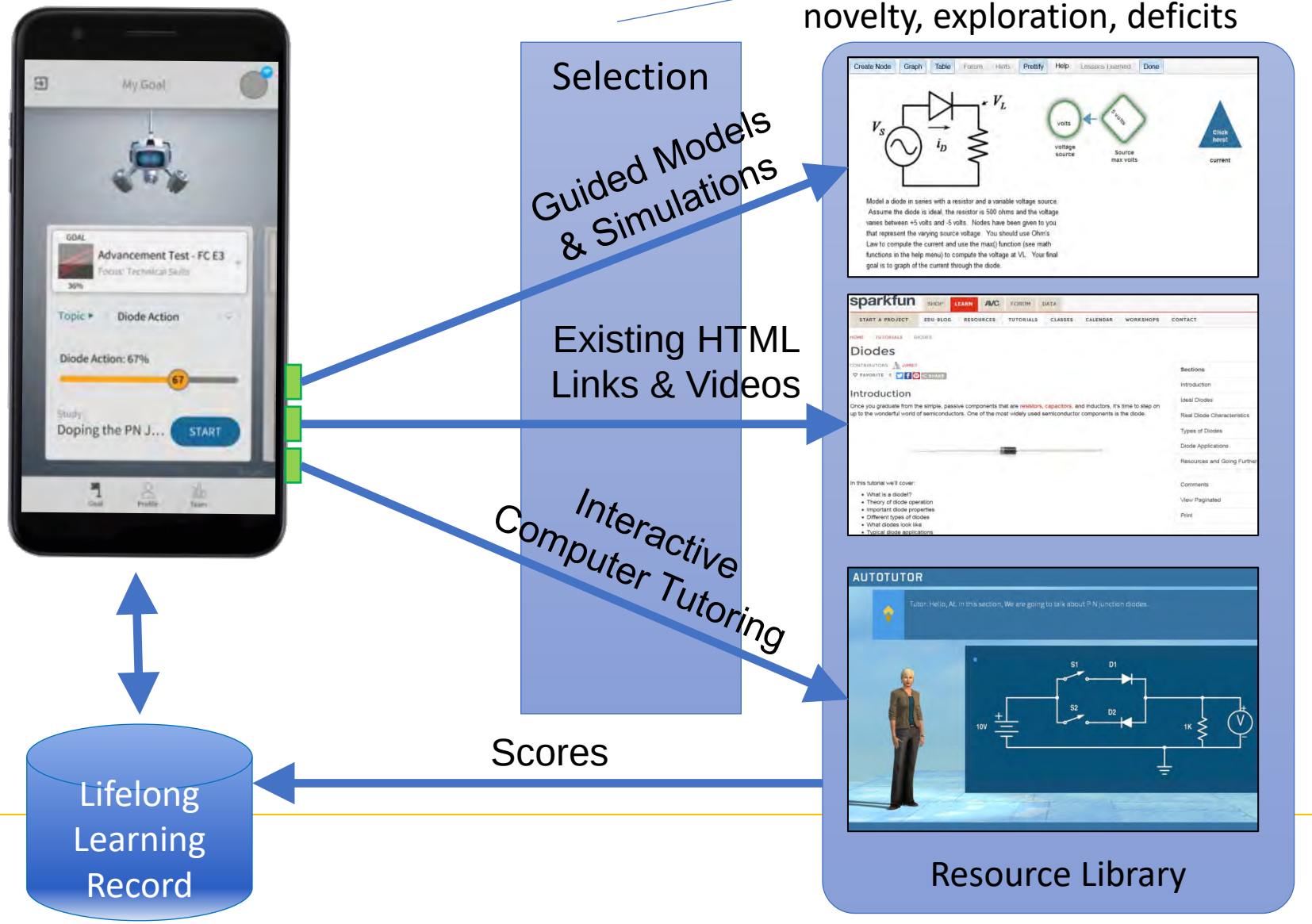
- Useful Learning:
  Must be relevant and retained at point-of-need (career & life goals)
- Personalized Learning:
  Adaptively target topics and resources to maximize learning rate and mitigate skill decay
- Engaged Learning
  PAL3 intended to be used voluntarily; Use techniques from learning sciences, games, social media to create engagement
- Available Learning
  Always available, always with you (mobile-based)
- Life-Long Learning:
  Build habits and motivation that foster effort, ongoing engagement, and learning over time



Personalized Recommendations

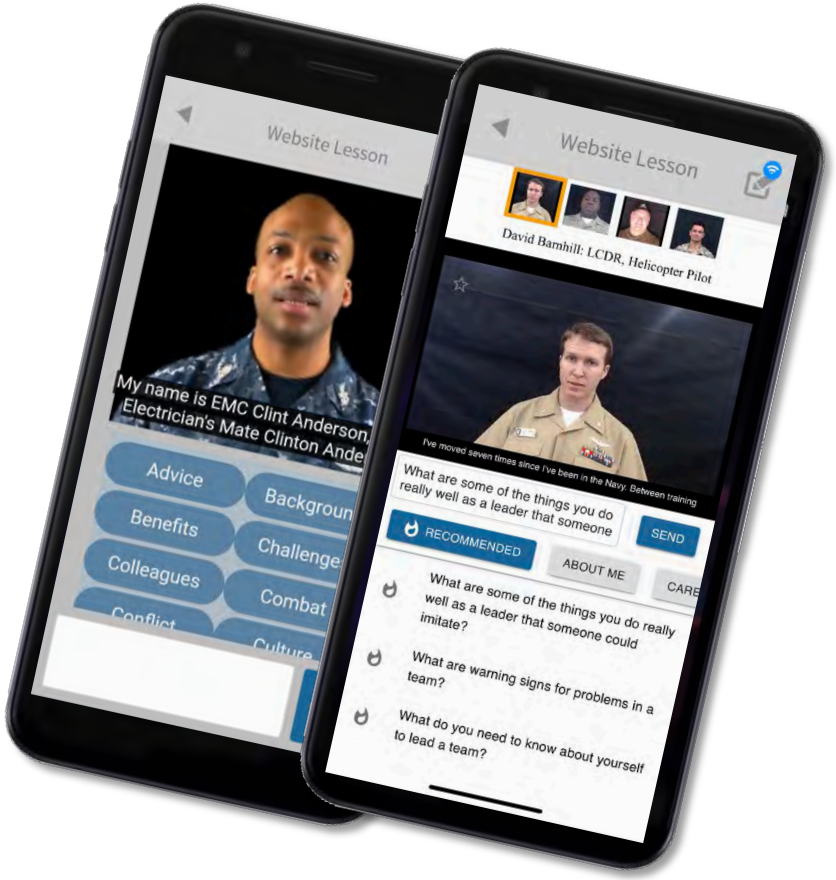


Evaluations

- Controlled study at Great Lakes showed elimination of knowledge decay (tablet version)
  - Areas covered: Basic electronics
- Recent controlled study with junior officers showed significant learning gains (16% pre-post; N=24; $p<0.001$; effect size 0.76)
  - Areas covered: communication & counseling; leadership; move & family adjust; suicide bystander

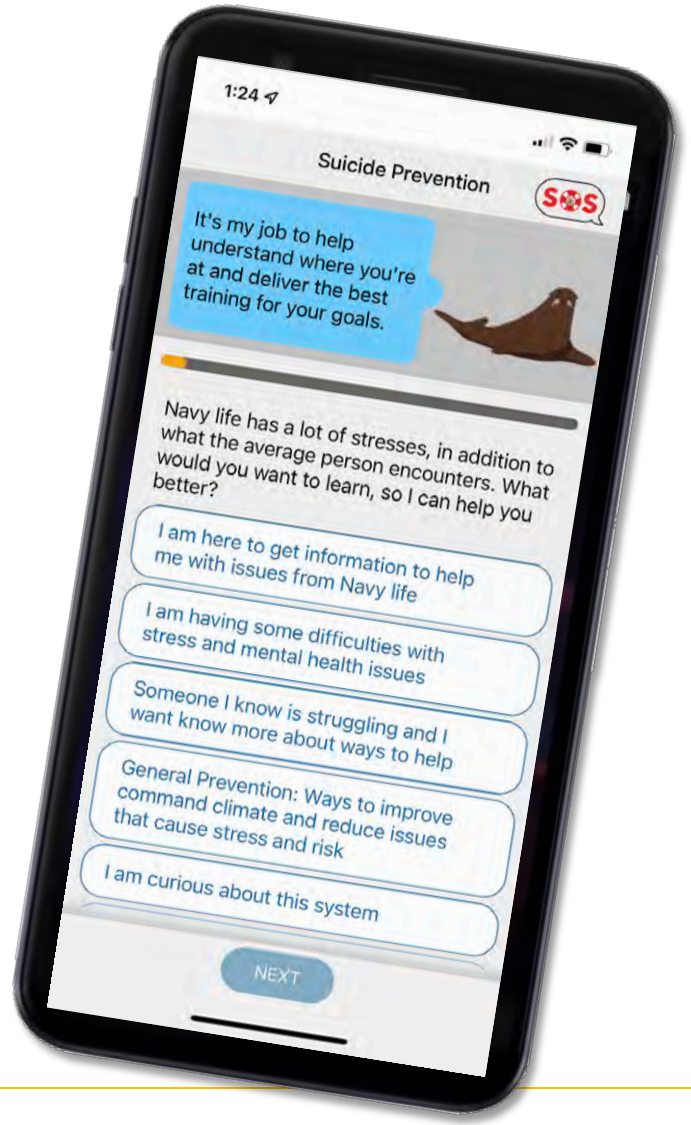
Virtual Mentors

- MentorPal: AI-based conversations with real mentors
  - Help with transitions
  - Make best mentors available broadly
- MentorPanel
- MentorStudio
  - Use AI to ease creation of virtual mentors (funded by NDEP)



SAFER: Safety Assistant for Excellence and Resilience

- Suicide Prevention Training
  - Used content from Navy N17
  - Added quizzes, tutorial dialogues, mentors
  - Initial interactive questionnaire with sailor used to prioritize training, e.g. help for self vs. helping others, lethal means, etc.



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Rapid Integration & Development Environment (RIDE)

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Kyle McCullough
Director of Modeling & Simulation
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Objective

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Inform next-generation military simulation and training

by means of an integrated R&D framework

that facilitates interdisciplinary collaboration

between academia, government, and industry

R&D: Research and Development

Approach

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Simulation environment **testbed** to provide an enhanced capability to accelerate the **development**, **assessment**, **testing** and **validation** of **emerging technologies** and simulation prototypes

Facilitates collaboration and experimentation within a shared environment between Government, Industry and Academia

RIDE Pillars & Example

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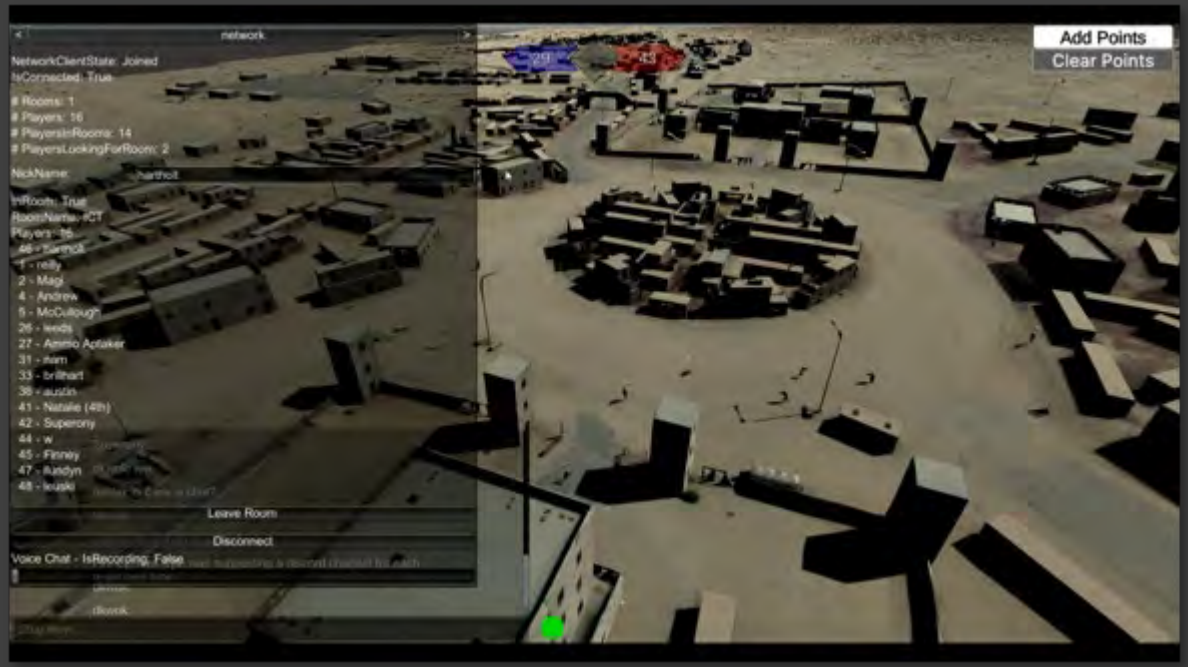
- One World Terrain (OWT) – Kyle McCullough
- AI / ML Support – Andrew Gordon & Volkan Ustun
- Virtual Humans
- Networking
- Multiplatform Support



RIDE Architecture

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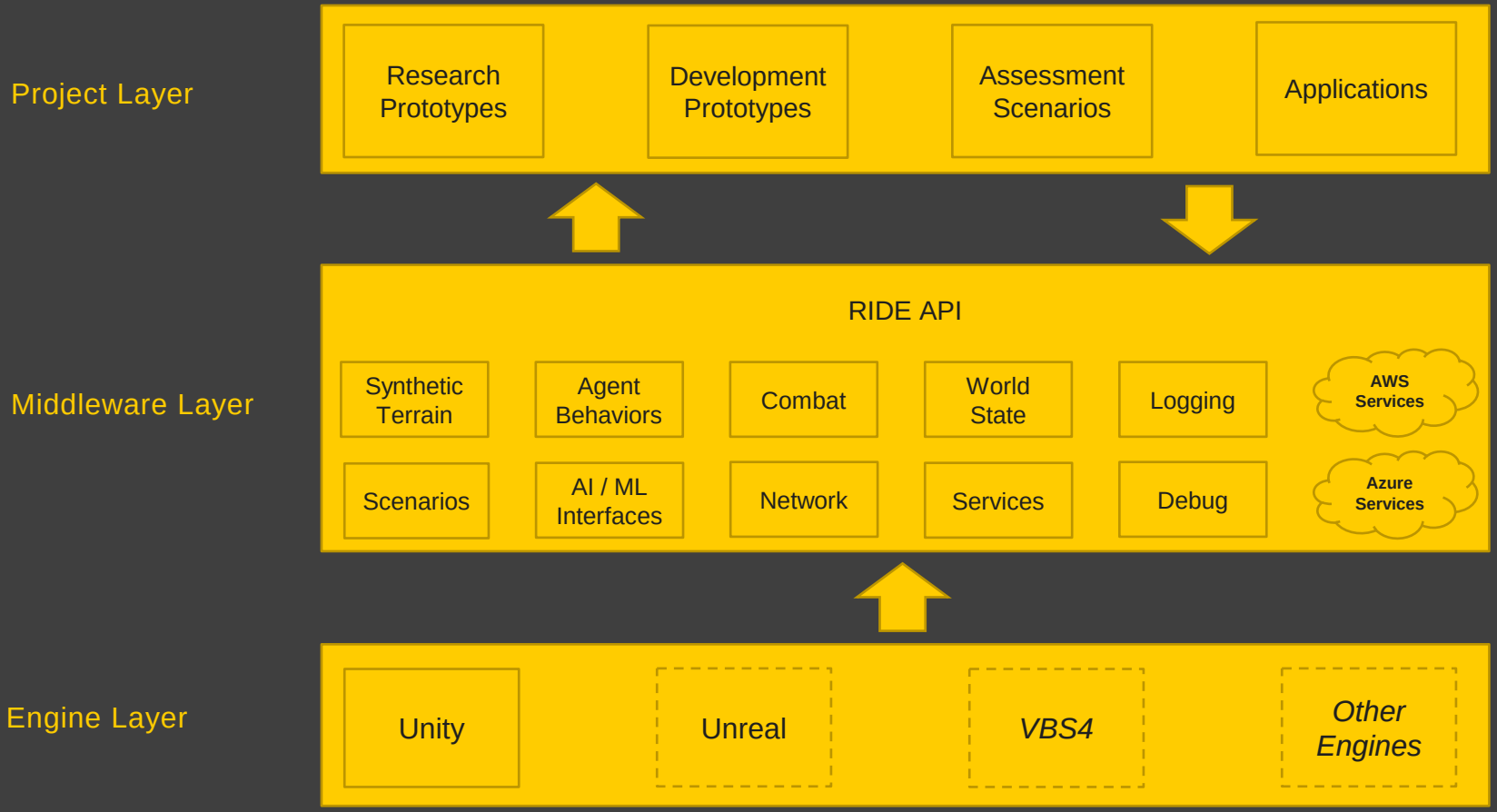

Advantages

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Integrated features

- Native One World Terrain (OWT) support
- Focus on AI and Machine Learning
- Built-in networked use cases and autonomous agents
- Session recording & playback
- Multi-platform (Win, Mac, Linux, iOS, Android, Augmented Reality (AR), Virtual Reality (VR), streaming)

Researcher and developer friendly

- Rapid prototyping through principled API
- Dedicated tutorials, examples and documentation
- Simulation focus to leverage game engines by non-game specialists

Future proof and legacy compatible

- Interoperable w/ web services, DIS messaging, ActiveMQ, xAPI
- Game-engine agnostic framework promotes exploration and avoids vendor lock-in

Community focused

- Quick and easy access through GPR
- Permissible 3rd party content
- Both quarterly and nightly releases
- Broad user base (30+ organizations)

ActiveMQ: Apache Active Message Queuing
API: Application Programming Interface
DIS: Distributed Interactive Simulation
GPR: Government Purpose Rights
xAPI: Experience Application Programming Interface

Example: Razish at Ft. Irwin

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Example: Razish at Ft. Irwin

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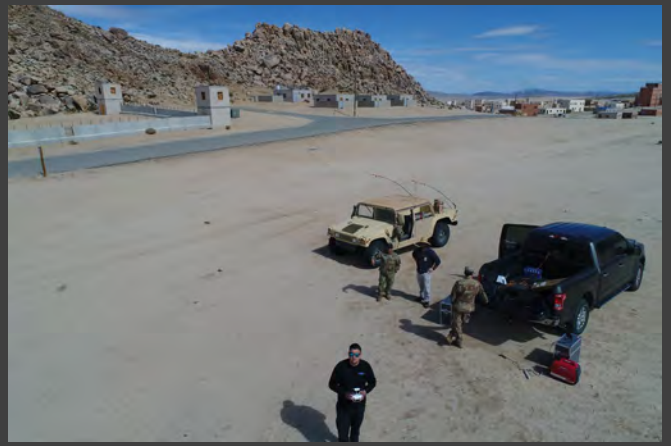

RIDE AI Architecture

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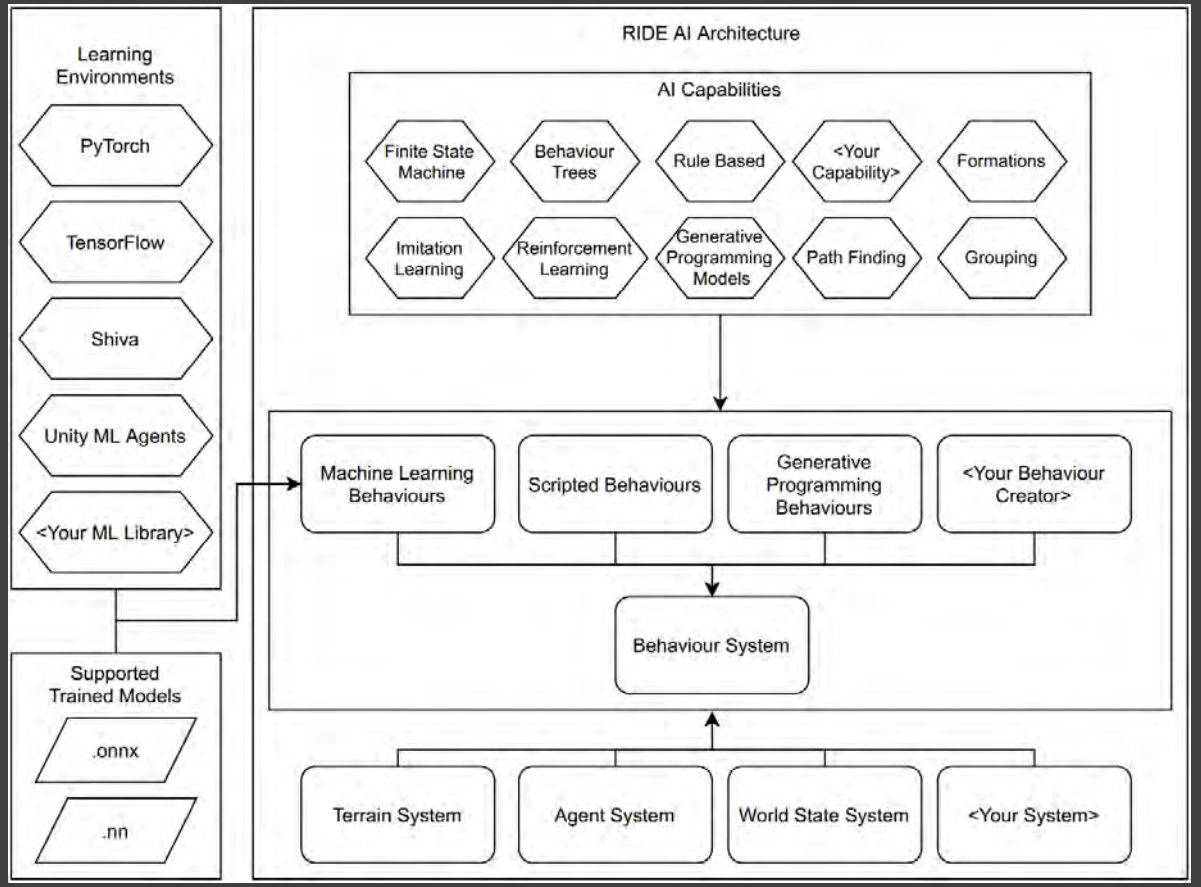
- Modular
- Leverages industry
- Vendor agnostic
- Integrates Terrain, World, Scenarios



Agent Behavior Authoring Tool

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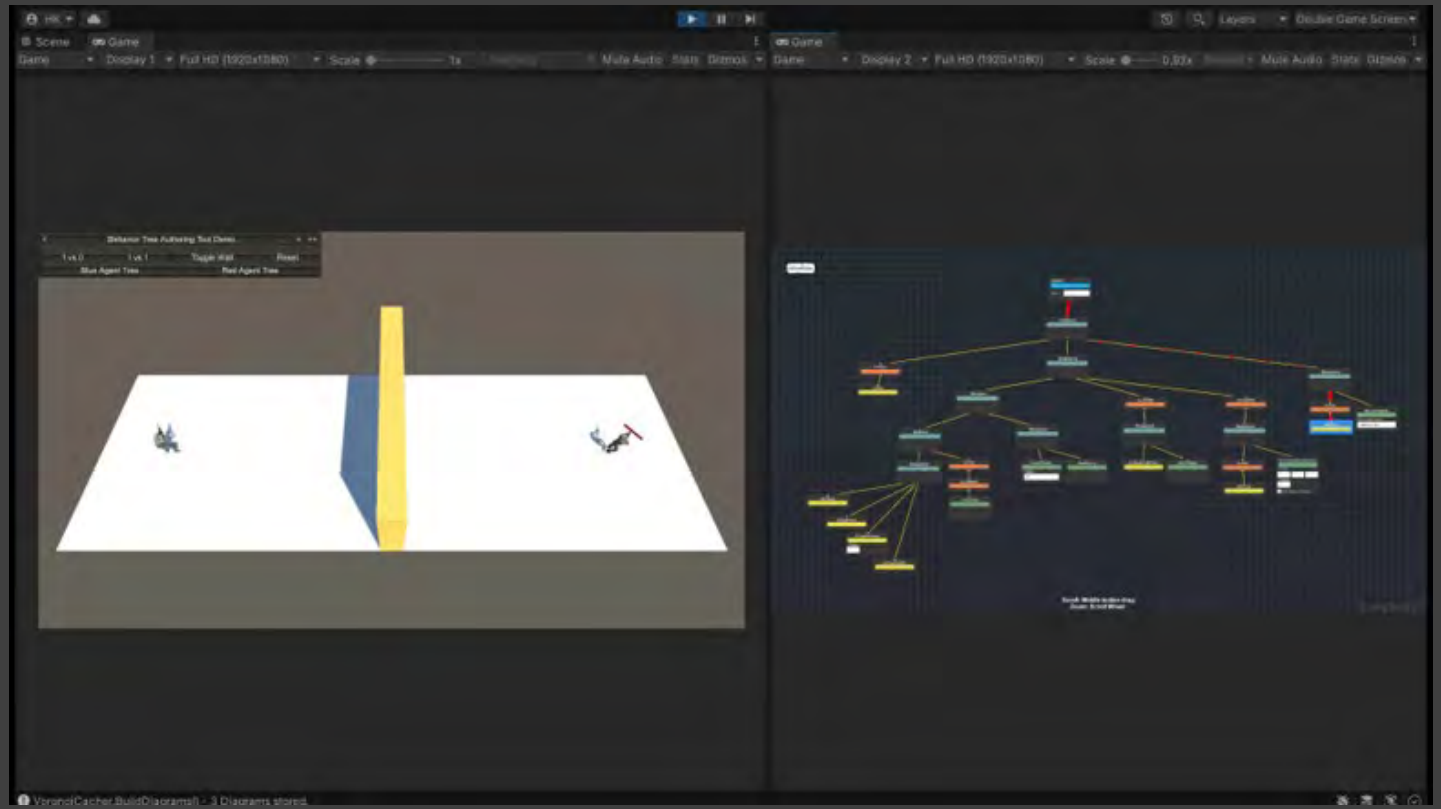

ML Interfaces

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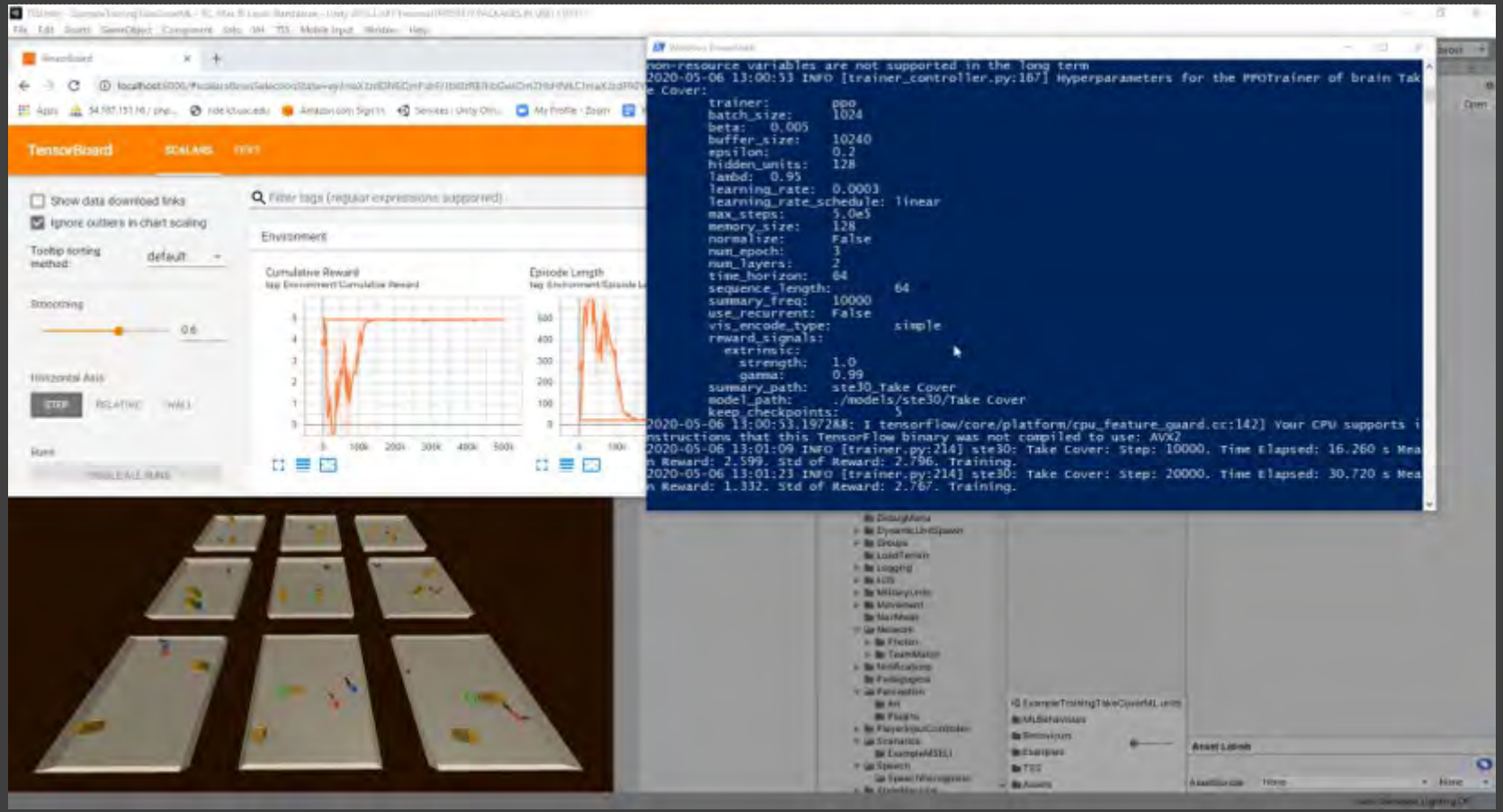

ML Agent Behaviors in RIDE w/ OWT

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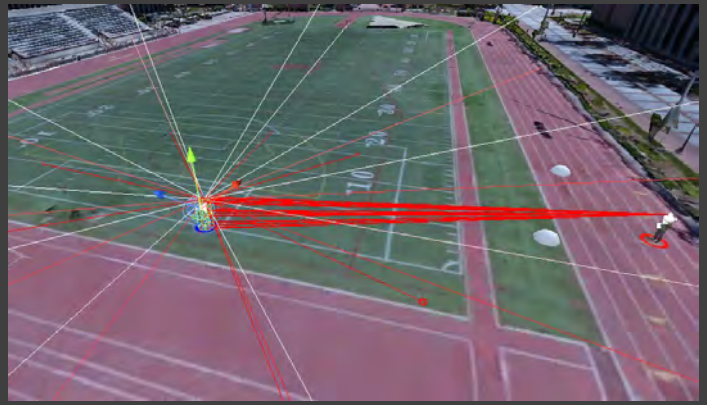

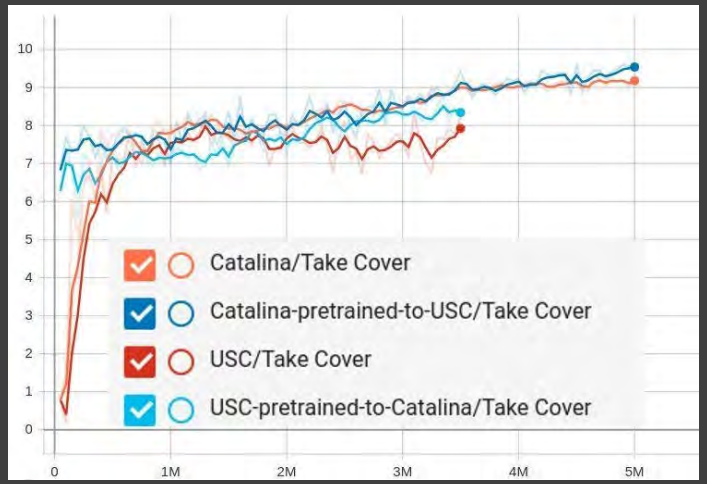

ICT Virtual Humans

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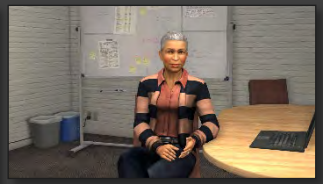

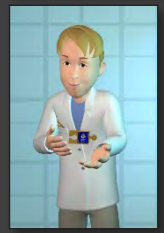

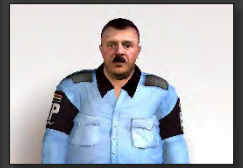

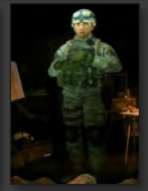

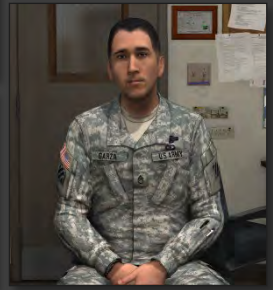

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Integrated Virtual Human Architecture

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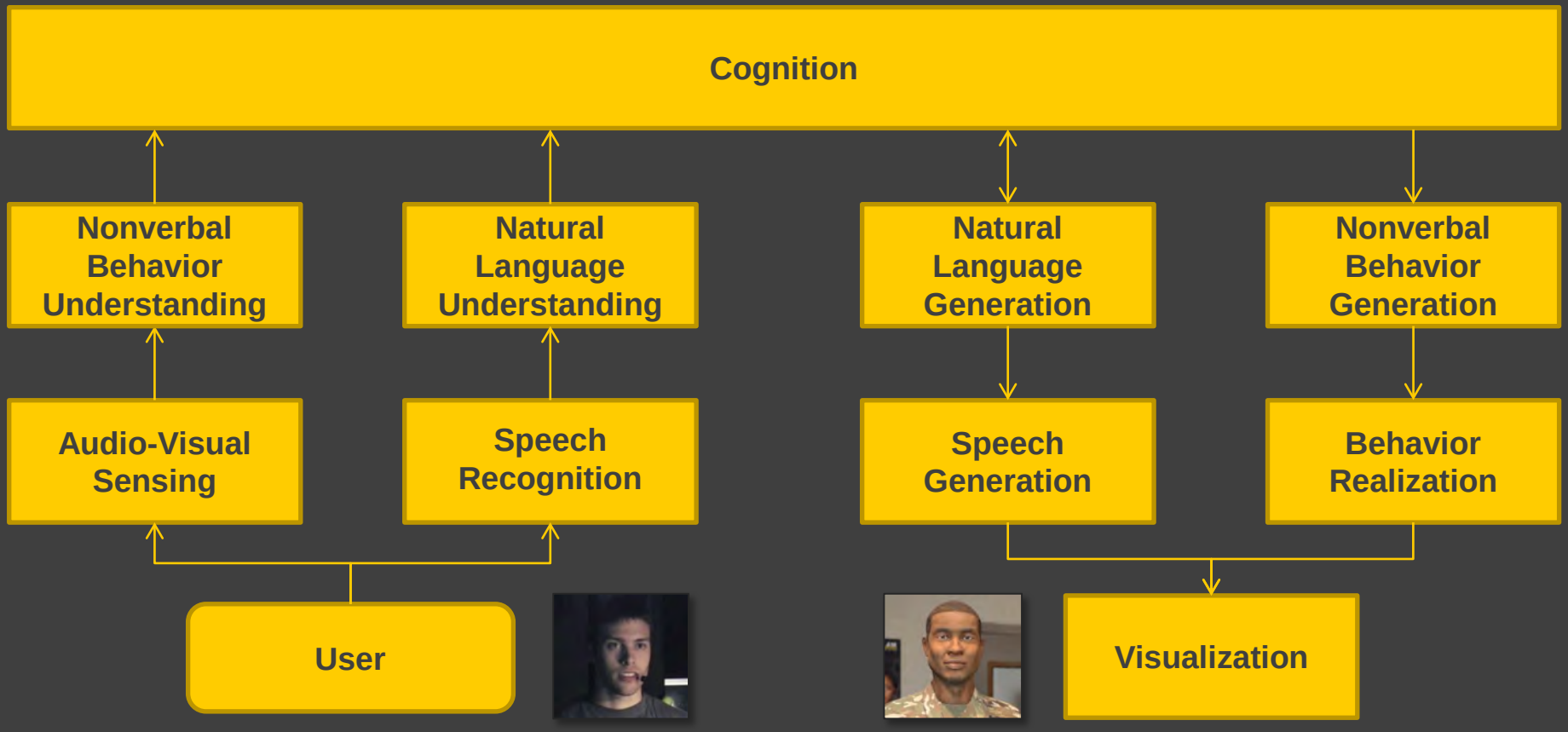

RIDE Integration

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Bring VH capabilities into RIDE

Dedicated VH RIDE systems

Retains VH modular architecture and interface

Leverages RIDE capabilities:

- One World Terrain
- AI web services

RIDE Collaborators and External Users

Questions?

RIDE
RAPID INTEGRATION
& DEVELOPMENT ENVIRONMENT

https://ride.ict.usc.edu ride@ict.usc.edu

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USC University of Southern California

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An Army-sponsored University Affiliated Research Center

DIVIS

DIGITAL INTERACTIVE VICTIM INTAKE SIMULATION

AFTER ACTION REVIEW

Project Leads: David Nelson, David Cobbins, Alesia Gainer, David Traum

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Training

“Infantrymen must fight 25 bloodless battles before they ever face real life-or-death combat.”

- Gen. James Mattis

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Army SHARP Program: SARC/VA Training

Army SHARP Academy SARC/VA Training

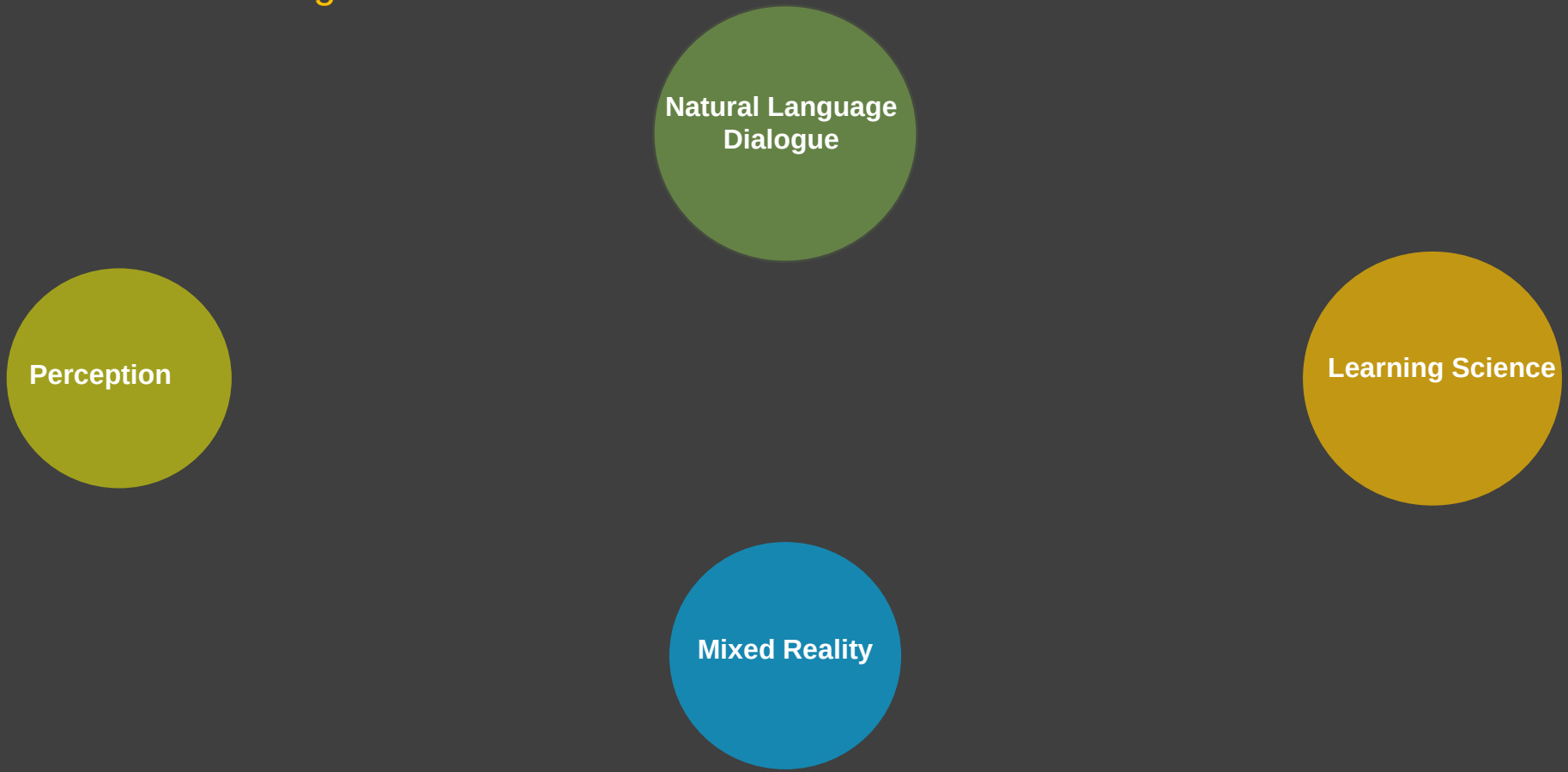
SARC/VA Career Course:

- 6-week course, designed to meet DOD Sexual Assault Prevention and Response Office's core competencies.
- Capstone – Victim Intake Interview Evaluation

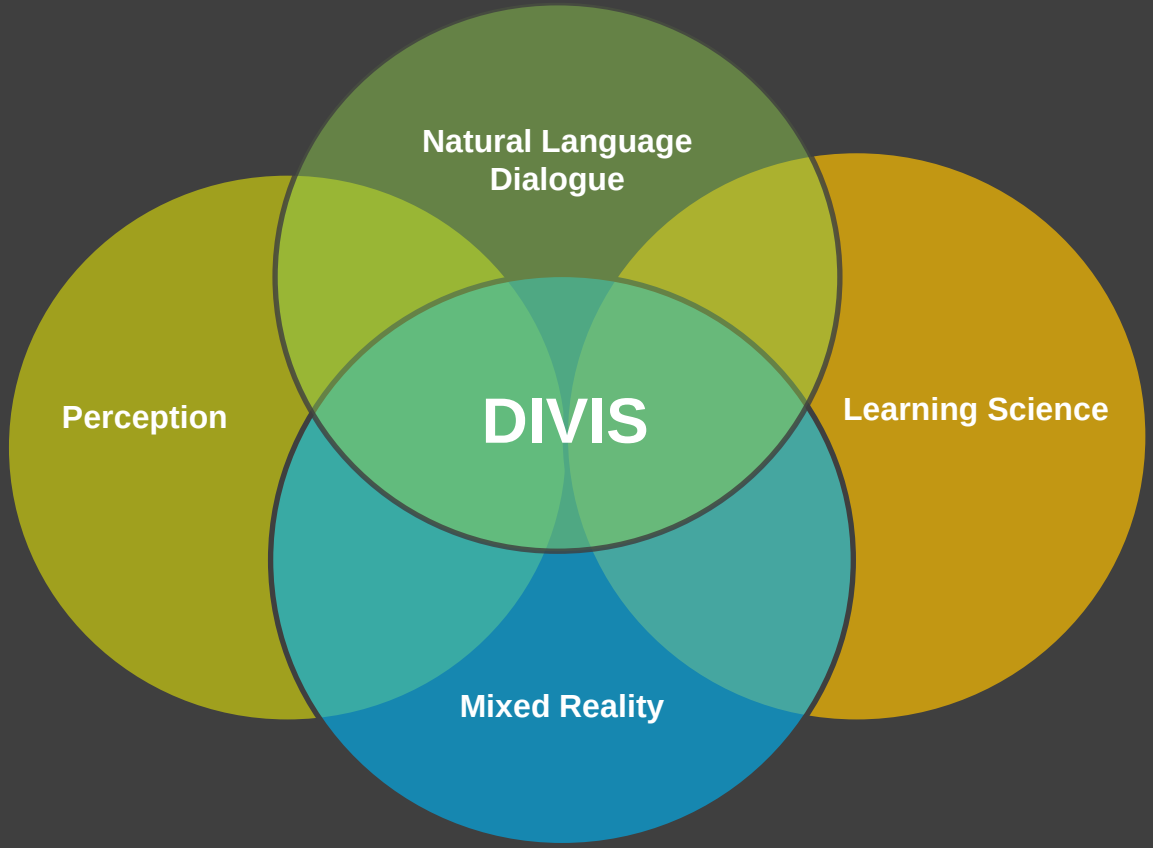
DIVIS – Digital Interactive Victim Intake Simulation

- Standardized Interactive Training Experience
- Realistic Natural Intake Interviews with ‘Digital Victims’
- Varied Challenging Scenarios
- Instructor Lead After-Action Review Interactive Dashboard

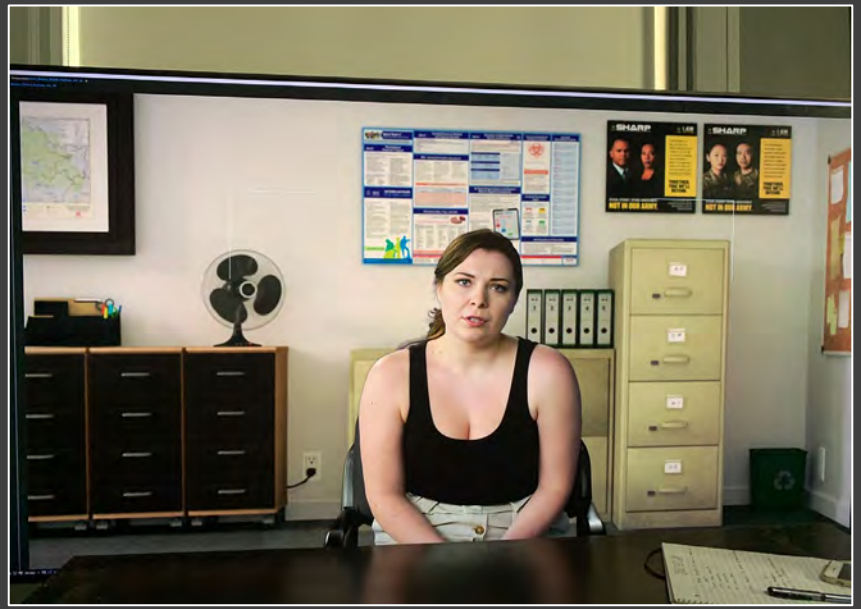
DIVIS – Digital Interactive Victim Intake Simulation



DIVIS – Digital Interactive Victim Intake Simulation



DIVIS – Digital Interactive Victim Intake Simulation



Realistic, authentic and unpredictable intake interviews.

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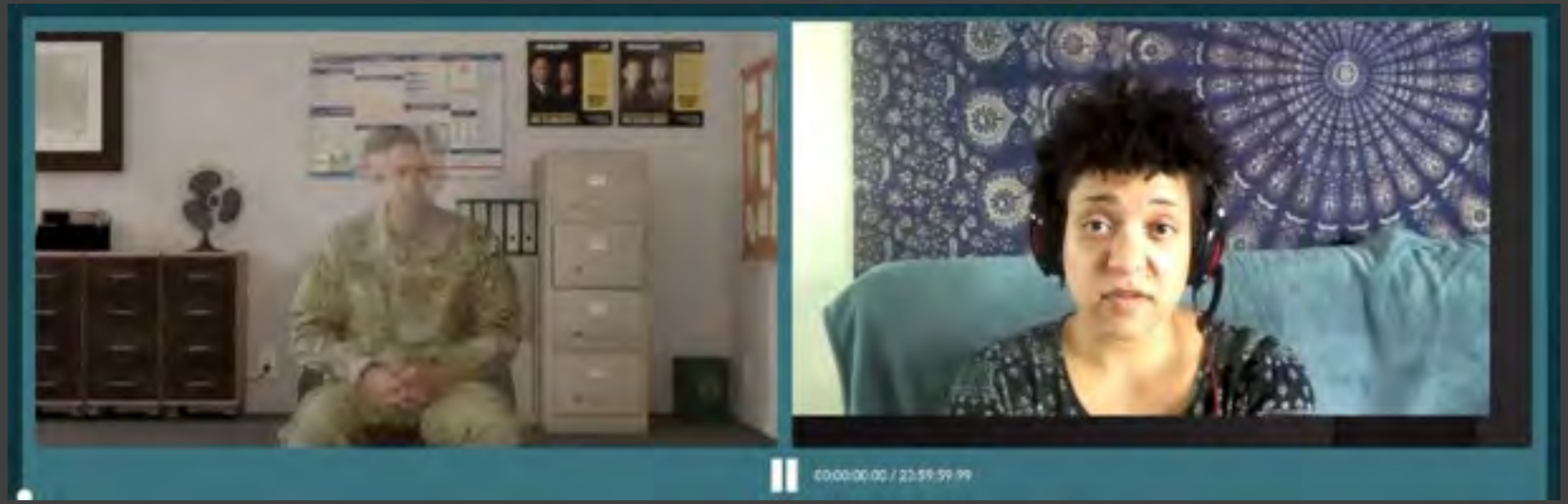
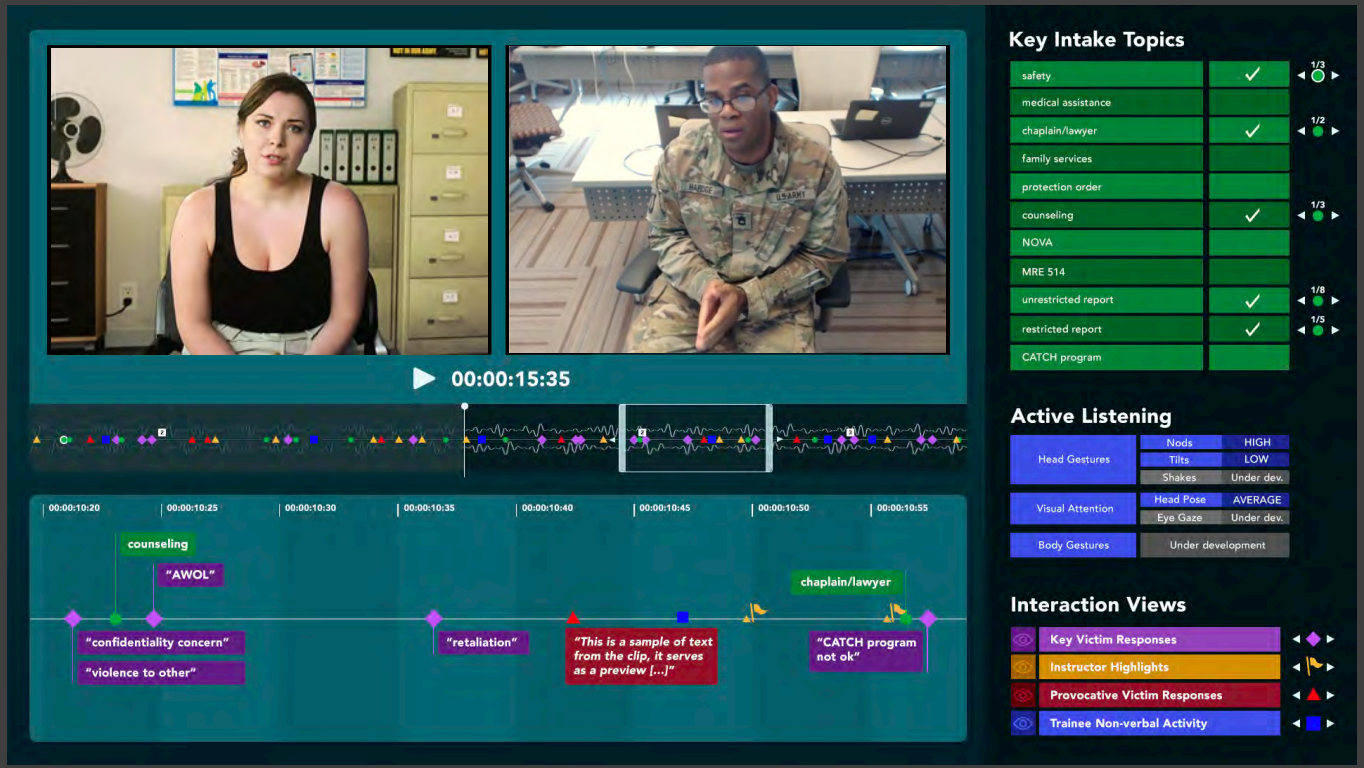
DIVIS – Digital Interactive Victim Intake Simulation



DIVIS – Digital Interactive Victim Intake Simulation - AAR



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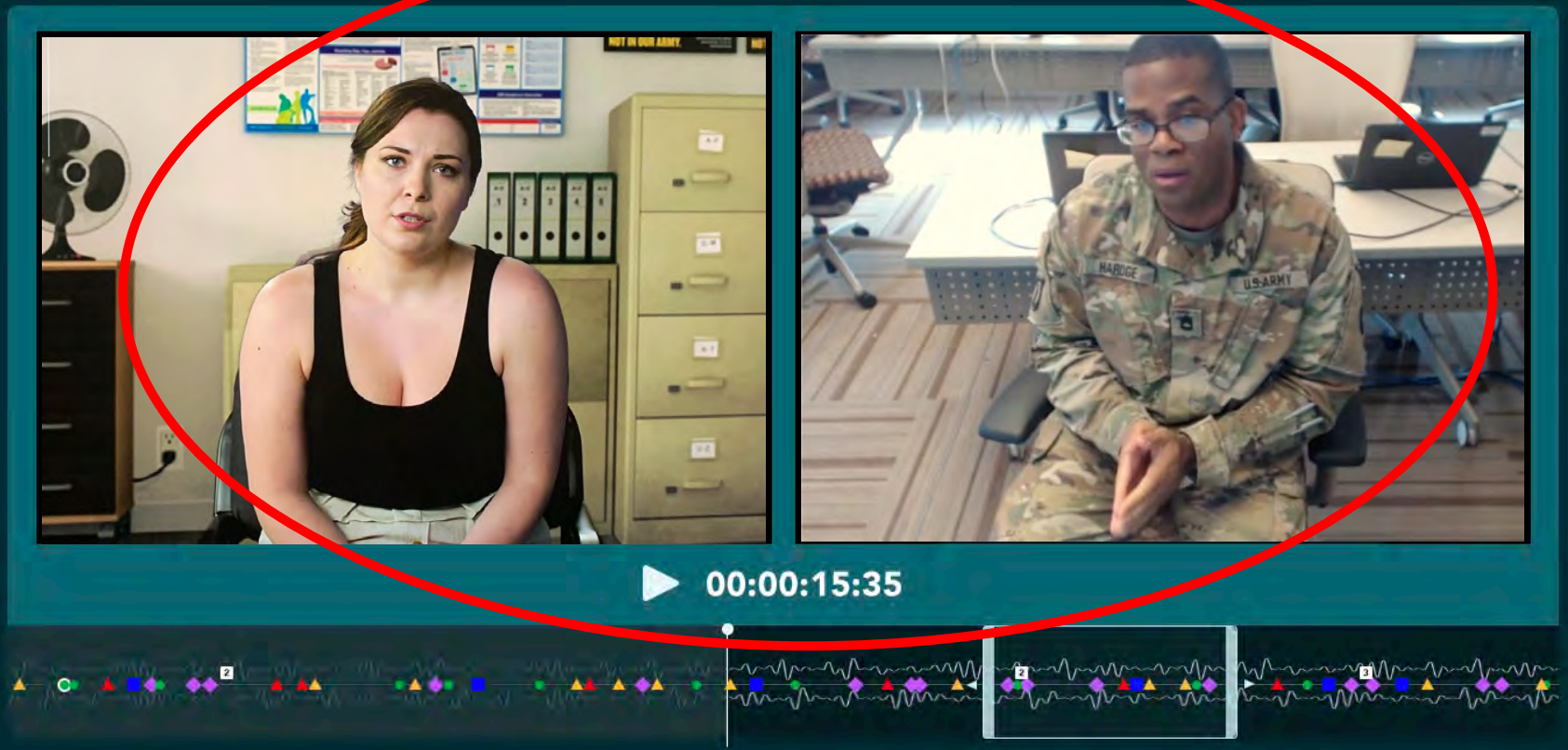
DIVIS – Digital Interactive Victim Intake Simulation - AAR



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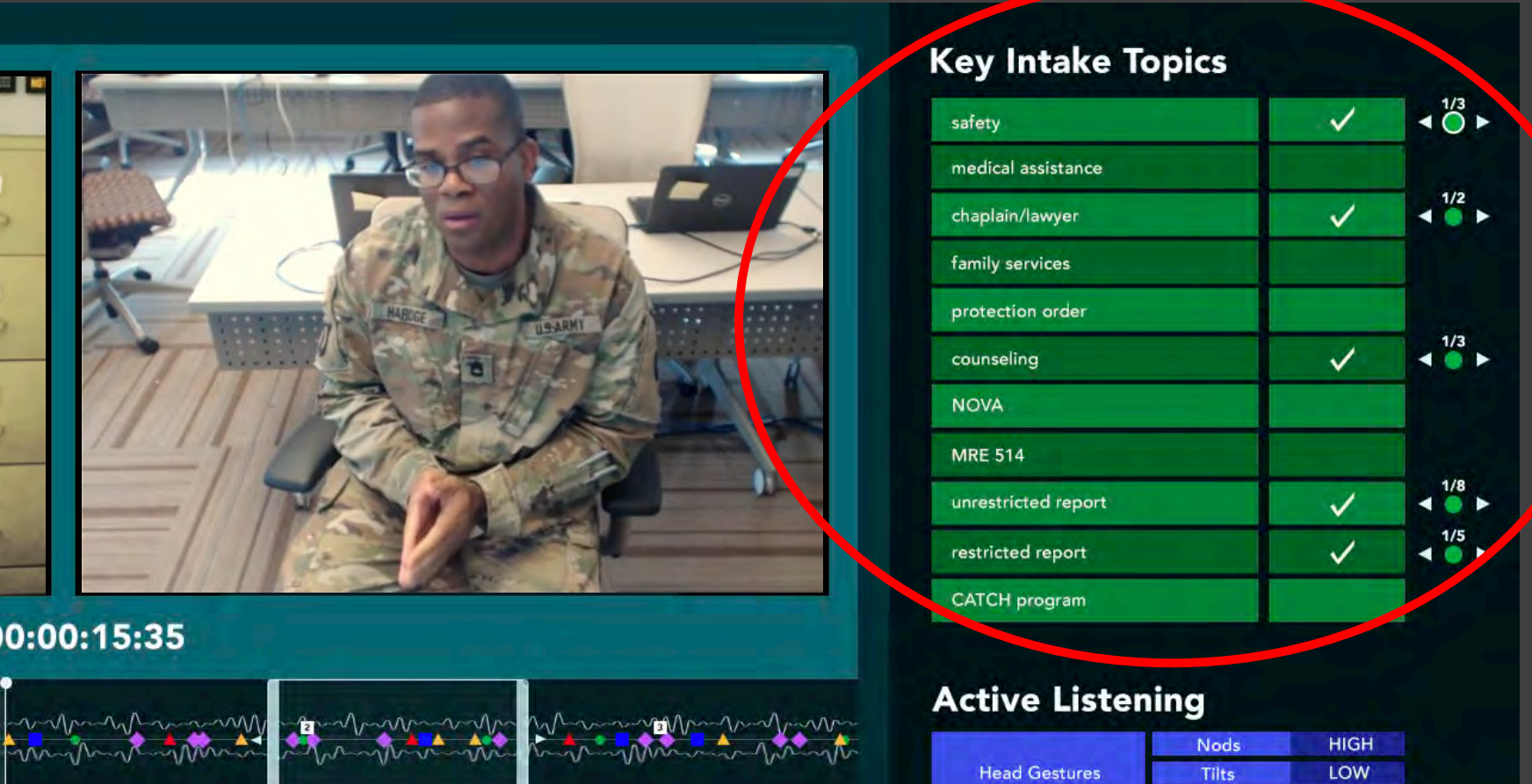


protection order	
counseling	✓
NOVA	
MRE 514	
unrestricted report	✓
restricted report	✓
CATCH program	

1/3 1/8 1/5

00:00:15:35

00:00:10:35 | 00:00:10:40 | 00:00:10:45 | 00:00:10:50 | 00:00:10:55

chaplain/lawyer

"retaliation"

"This is a sample of text from the clip, it serves as a preview [...]"

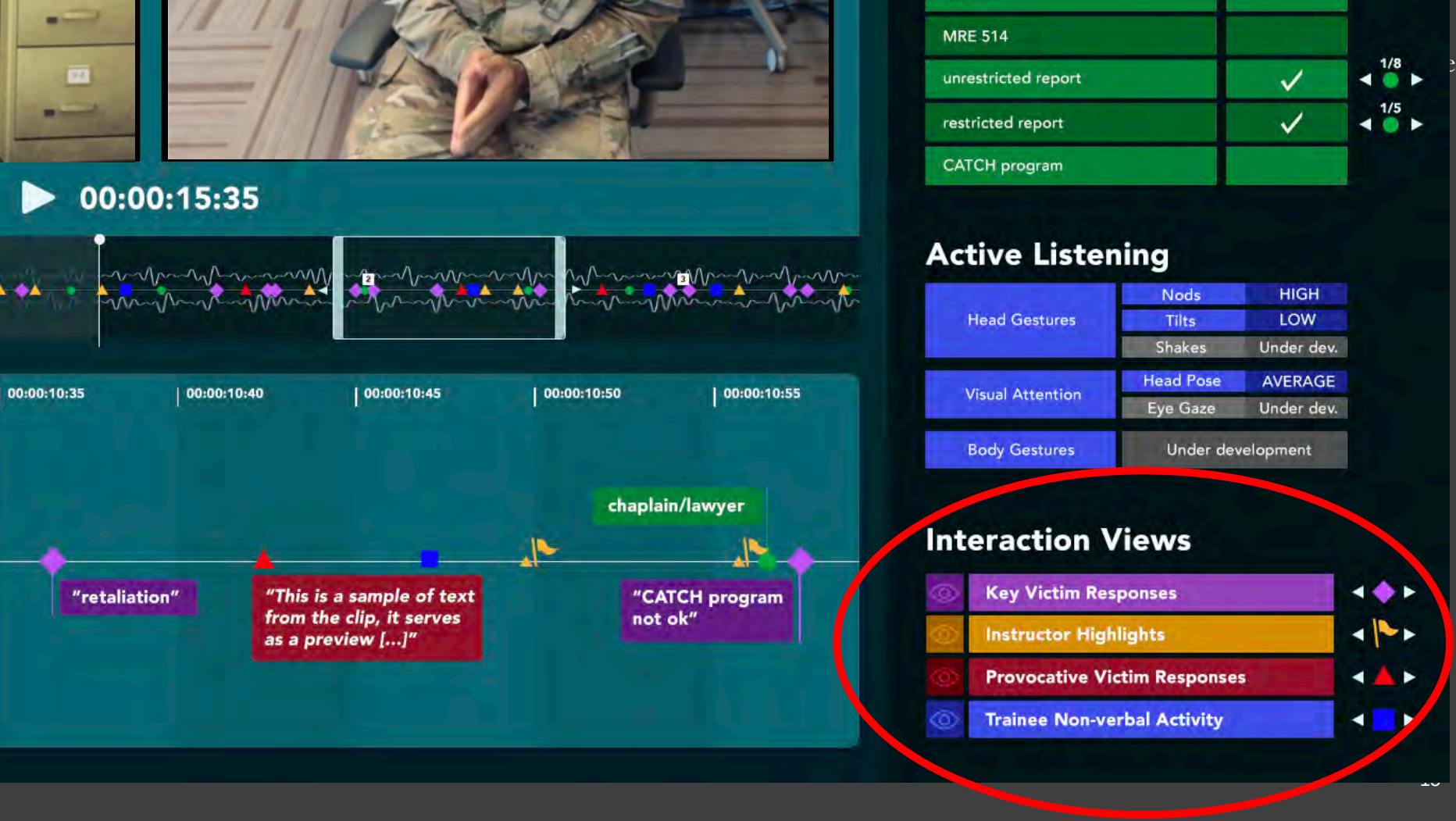
"CATCH program not ok"

Active Listening

Head Gestures	Nods	HIGH
	Tilts	LOW
	Shakes	Under dev.
Visual Attention	Head Pose	AVERAGE
	Eye Gaze	Under dev.
Body Gestures	Under development	

Interaction Views

- Key Victim Responses
- Instructor Highlights
- Provocative Victim Responses
- Trainee Non-verbal Activity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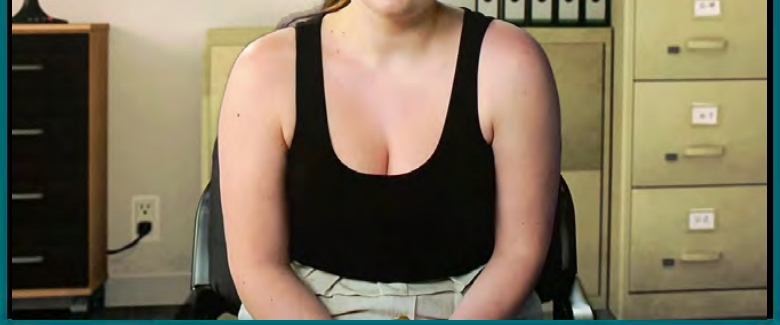

protection order
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CATCH program

00:00:15:35

00:00:10:25 | 00:00:10:30 | 00:00:10:35 | 00:00:10:40 | 00:00:10:45 | 00:00:10:50

counseling
"AWOL"
chaplain/lawyer
"confidentiality concern"
"violence to other"
"retaliation"
"This is a sample of text from the clip, it serves as a preview [...]"
"CATCH program not ok"

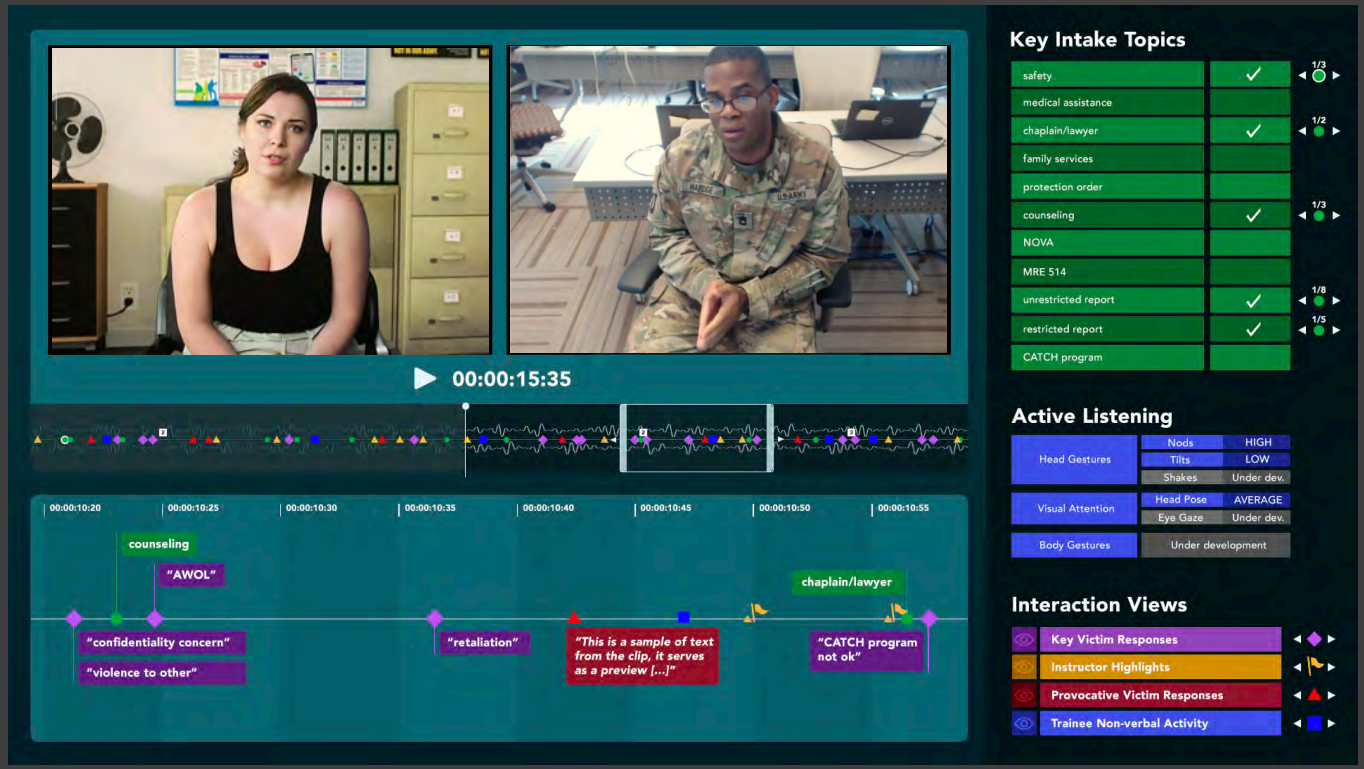
Active List

Head Gestures
Visual Attention
Body Gestures

Interaction

Key Victim
Instructor
Provocativ
Trainee No

DIVIS – Digital Interactive Victim Intake Simulation - AAR



Partners

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- Colonel Christopher H. Engen, U.S. Army Director, SHARP Academy
- Anthony R. McNeill, Deputy Director, U.S. Army SHARP Academy
- Gregg Buehler, Chief, Academic Operations, U.S. Army SHARP Academy

Medical Research and Materiel Command

- Katharine Nassauer, Ph.D, Psychological Health and Resilience Portfolio Manager, Military Operational Medicine Research Program
- MAJ Karmon Dyches, Ph.D, Military Deputy for Psychological Health Military Operational Medicine Research Program

STTC

- John Hart, Program Manager

Sub-Contract

- Rick Castaneda, for all production and Post-Production Services.

Subject Matter Experts

- Nichol Borland, 10th Mountain DIV SHARP Trainer, Fort Drum
- Rachel Thanos, Victim Assistance Analyst, D-SAACP Operations Manager, DoD Sexual Assault Prevention and Response Office, Alexandria, VA
- Bette M.S. Inch, MSCP, CA, Senior Victim Assistance Advisor, DoD Sexual Assault Prevention & Response Office (SAPRO), Director, DoD Safe Helpline and D-SAACP, Alexandria, VA

USC University of Southern California

USC Institute for Creative Technologies

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Thank you.

For follow up conversations please contact:

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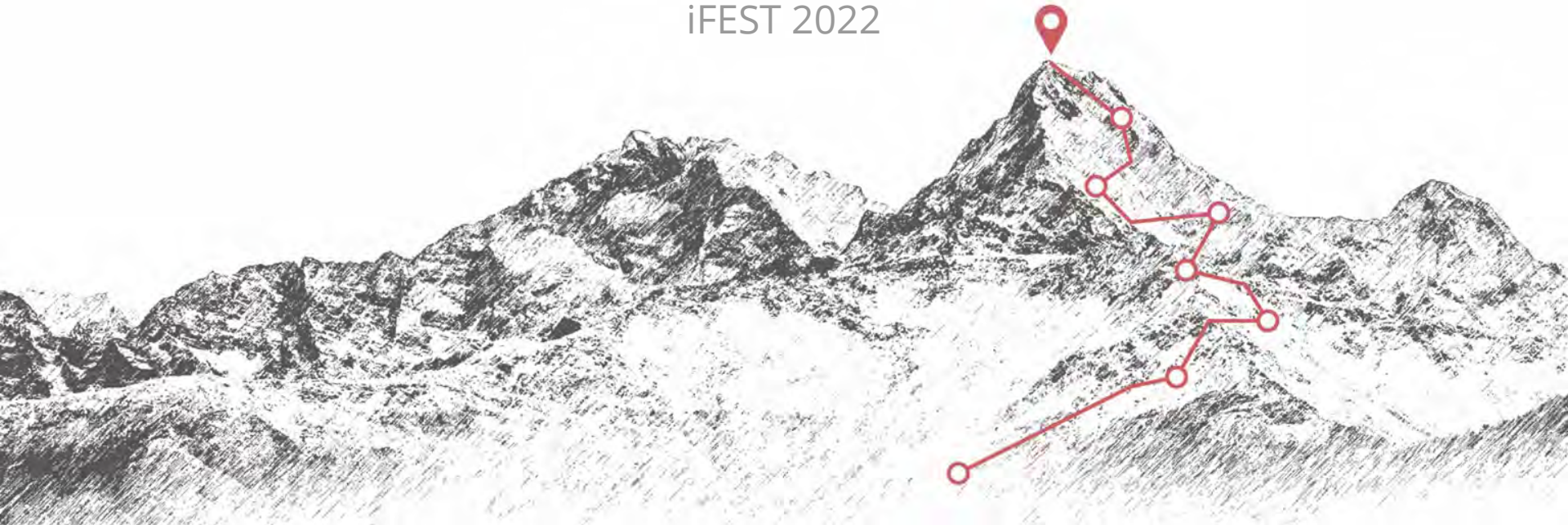
CaSS and DoD: OMEGA and Beyond

USC ICT - DoD's Newest Learning Technologies

iFEST 2022



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OMEGA: Measuring the Unobservable

Machine Learning Automated Engagement Metrics for Pilot Training Transformation

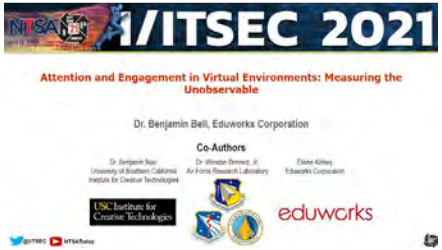
PTN training transformation
- Using VR for all ground-based flying training

Goal: Enhance objective performance data
- Engagement #1 factor in learning retention
- Hard to measure directly, need indirect metrics

Approach: Machine Learning-derived metrics

Results: Preliminary positive validation that OMEGA detects engagement lapses.

Broader relevance for training pipelines & platforms



Best Paper I/ITSEC 2021

https://tinyurl.com/bdzevkfc

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OMEGA Summary: Evaluator Thumbs Up

OMEGA was good at detecting engagement lapses

- Triggered alerts in response to shaky, distracted flying
- "Could see a notification and know with 80% certainty that something should be looked at"

Recommendations timely and thorough

- Timeliness: Detected periods indicating disengagement or performance lapse
- Coverage: Few OMEGA misses where instructors would have intervened

Bottom Line: Disengagement detector overall quite successful

- Events detected and identified in time
- Sufficient granularity to drive training recommendations

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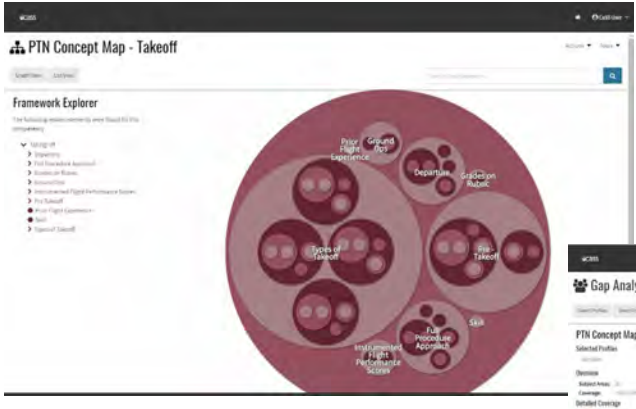
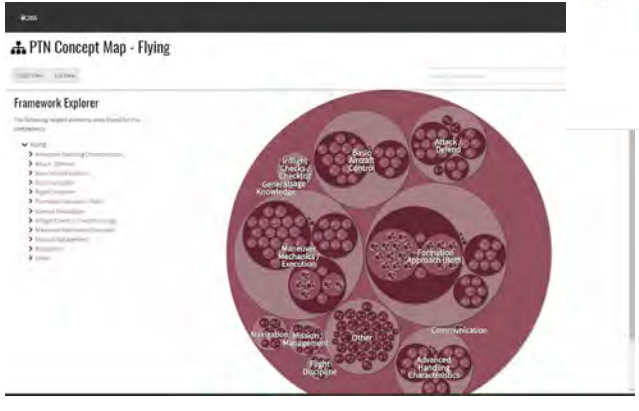
CHECK-SIX: Automated Assessment Metrics

Capture automatically-generated learning metrics in CaSS

- Machine learning models measure attention & engagement
- Metrics update competency profiles

Test Case: Pilot Training Transformation; CaSS + metrics to improve training effectiveness





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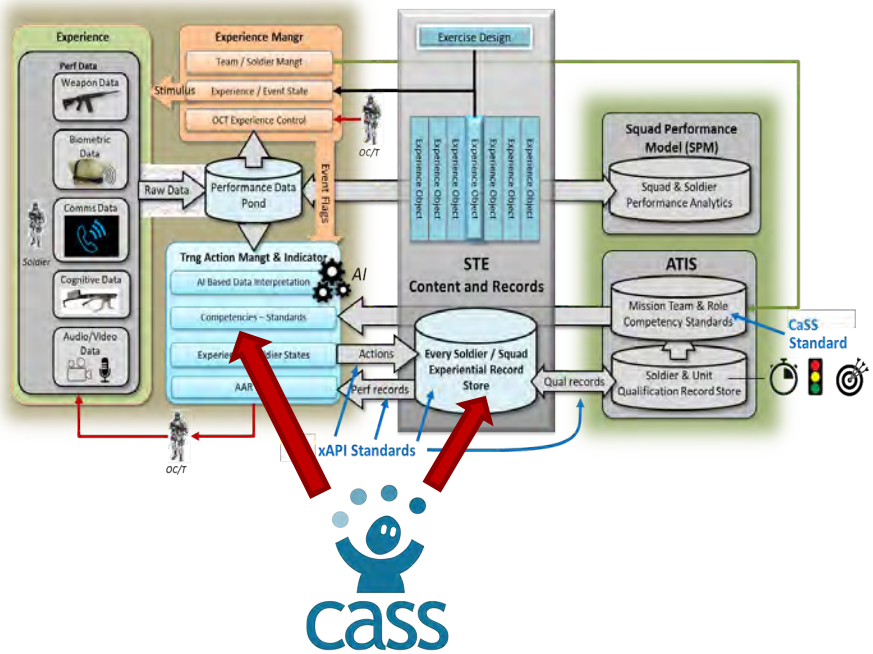
STEEL-R: TLA for Experiential Learning

Synthetic Training Environment Experiential Learning – Readiness (STEEL-R)

Integrates real-time STE training w/ training & readiness dashboards. Training modalities include simulation, AR/VR, mixed reality, and in-person measurement.

Interoperates with the Army Training Information System (ATIS) to exchange verified information.

Informs ATIS of training experiences of Soldiers linked to evidence.



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Best Paper Nominee I/ITSEC 2022

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CaSS for the US Navy

Rating & Career Domain Continuum (RCDC) Development

- Unique CaSS tool to enable S6000T ADDIE process to be conducted digitally across teams
- Provides a training development pipeline for product lifecycle management

My Navy Learning (NETC)

- Digital brokering of work, readiness, and learning between afloat and ashore
- Building the first digital dictionary for Navy-wide sailor performance
- Delivering high fidelity views of Sailor skills w/ 90,000+ Navy competencies stored in CaSS

Surface Training Readiness and Management System (STRMS)

- Transforms a range of data afloat into information for Sailors and Leadership
- Connects what happens in the Fleet to what happens in the classroom
- Provides views into human performance across the US Navy upon transition