



Human Performance

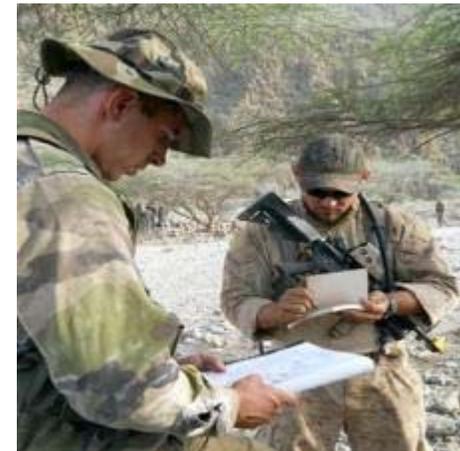
Integrity ★ Service ★ Excellence



Human Performance



- **Human Performance Mission:**
 - Develop human-centered science and technology research to optimize and protect the Airman's capabilities to fly, fight, and win in air, space, and cyberspace
- **Human Performance Technology Vision:**
 - *Lead the Air Force in Human-Centered Research.*
- **FY14 Investment: \$60M**

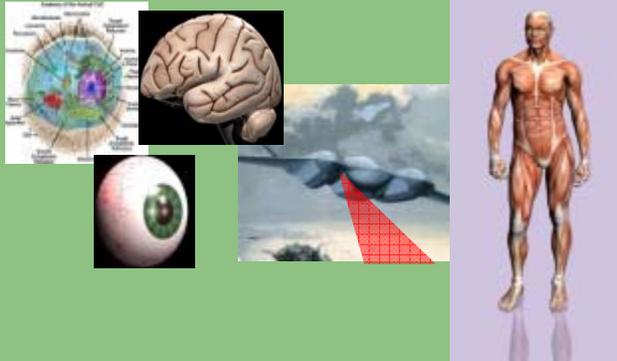




Human Performance Core Technical Competencies (CTCs)

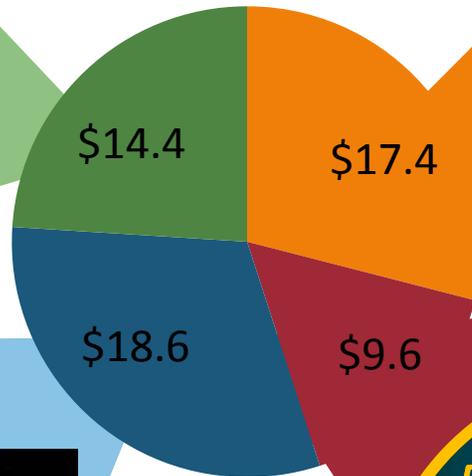


Bioeffects



Human Performance
(\$60 M FY14 TOA)

Training



Basic Research



Decision Making





\$19 M/Yr

Human Performance Basic Research



Dr. David Atkinson at Institute for Human and Machine Cognition is developing a mixed-initiative interaction that will improve interaction of humans and their machines.

Motivation

- Produce overwhelming speeds and scales, without limits imposed by the number or readiness of personnel during operations
- Multi-disciplinary investigations of performance in scenario-based cognitive tasks
- Create knowledge required for technologies capable of adaptively substituting for human experts

Mission/Vision Statement

Mission: We discover, shape, and champion basic science that profoundly impacts the future Air Force.

Vision: The U.S. Air Force dominates air, space, and cyber through revolutionary basic research.

Goals/Objectives

Goals: Discover new theory, models, and computational solutions for intelligent adaptive systems that better combine natural and machine intelligence.

Objective: To advance machine learning for fusion and adaptive knowledge assessment; cognitive replicates based on principles of human performance; adaptive immersion for seamless training/operations.

Technical Approach/Ideas

- Predictive models of individual, team, and organizational performance
- Representation of knowledge suitable for combined human and machine processing
- Unified models of human and machine learning, planning, and decision-making
- Artificial intelligence for human supervision of action selection in large scale semi-autonomous systems
- Understanding of the human role in cyberspace operations
- Exploit the structure and spatio-temporal scale separation using domain decomposition techniques





\$21 M/Yr

Human Performance Training CTC



Motivation

CHALLENGE: Training and Readiness requirements are outpacing capacity and existing opportunities to train

Mission/Vision Statement

Human performance methods and technologies providing the Warfighter the necessary knowledge and skill to dominate their operating environment

Goals/Objectives

- Increase training efficiency > 15%, training time decrease 30%
- Increase responsiveness: from wks/months to near-real-time
- Improve performance at the point-of-need
- Tailor design, delivery, and feedback for real time management
- Create common methods and metrics for cross mission applications

Technical Approach/Ideas

Cognitive Modeling – Defining how we think for systems use

- Develop cognitively rich synthetic agents for future training environments
- Define mechanisms underlying complex cognitive tasks
- Prescribe optimal training program

Continuous Learning – Leading the way for LVC

- Training outcomes in complex mission environments
- Accelerate development of mission critical competencies
- Optimize training value of live, virtual, and constructive environments





Training Strategy

Live-Virtual-Constructive



Near-Term (FY14-16)

Mid-Term (FY17-19)

Far-Term (FY20 ->)

Live-Virtual-Constructive (LVC)

Entire-Kill-Chain

EW A2AD



“one-off” training approach



distributed teams, distributed mission sets



complex, contested environments

← **Warfighter Training Readiness** →



Training CTC



Near-Term (FY14-16)	Mid-Term (FY17-19)	Far-Term (FY20 ->)
5 th Generation Scenario Studies	Human Cognition & Performance Simulations	Automated Tools for Adaptive LVC Scenario Generation
Integrated/Validated Tools for Live, Virtual, and Constructive (LVC) Training	Integrated Performance Measurement for AOC Training	Adaptive Training and Cognitive Modes for Complex Domains
AFSOC Training Rehearsal System	Cyber Training Simulations	Fatigue Monitoring for Air Traffic Controllers
Training Technologies for PCPAD	NASIC Training Testbed	Intelligent Training Tutors
Sharable Authoring, Assessments, and Adaption Tools for LVC	Synthetic Instructors for Teaching Humans	Synthetic Teammate For RPA Reconnaissance



\$36 M/Yr

Human Performance Decision Making CTC



Decision Making



Motivation

- Need to reduce personnel costs at same time mission demands increase putting stress on system operators
- New operating regimes resulting in unexpected human performance issues
- Need to meld humans and the ever-increasing automation that supports them into high performance teams

Mission/Vision Statement

We discover and transition innovative human-machine interface solutions to ensure effective warfighter decisions in Air Force operations.

Goals/Objectives

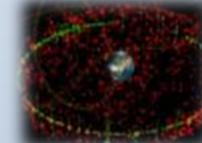
- Optimize linkages between man and automation
- Optimize human cognitive performance
- Take advantage of all modes of human communication to optimize information transfer based on situation

Technical Approach/Ideas



Battlespace Acoustics :

Battlefield Airmen ATD Transferred 13 Technologies
Sonic Counter-Detection – Strong ATD Candidate



Battlespace Visualization :

Space Situation Awareness (SSA)



Human Role in Semi-Autonomous Systems :

Multi-Role Control Station



Applied Neuroscience :

Cyber Operator Augmentation





Decision Making Strategy



Near-Term (FY14-16)

Perceptual
Battlefield Airmen
Sonic Counter Detection



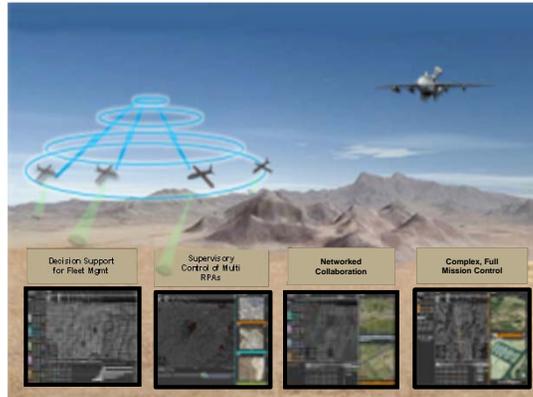
Combat Controller



Pararescue Jumper

Mid-Term (FY17-19)

Perceptual-Cognitive
UAVs
Multi-Role Control Station



Far-Term (FY20 ->)

Cognitive
Human/Machine
Decision Making



F-22
5th Gen
Single Point



Human/Machine Teams
Sharing Information



Autonomy, Shared
Decision Making



Decision Making CTC

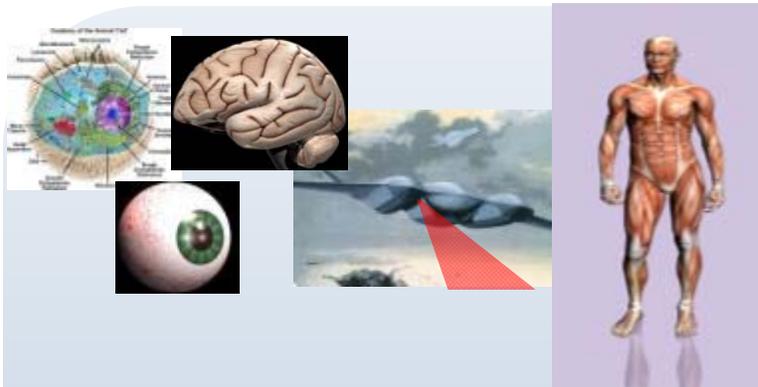


Near-Term (FY14-16)	Mid-Term (FY17-19)	Far-Term (FY20 ->)
Hypoxia Vulnerability Solution/Recommendations	5 th Generation Injury Exposure Modeling	F-35 Ejection Seat (spinal injury) Enhancement & Neck Injury Modeling
Advanced Tactical Headset	Aircrew Biodynamic Performance Modeling	F-35 Injury Mitigation Designs
F-35 Noise Impacts	Multimodal Tactical Comm System (BATMAN II)	Combat Interfaces for Mission Rehearsal (BATMAN II)
Team Workload Monitoring and Metrics	Cyber Performance Augmentation	Pararescue Battlefield Trauma Equipment / Interfaces
Complex Data Visualization Modeling	Advanced Human Machine Interface for RPA Control	Neuro Stimulation
Visualization of Fused Complex Scenes	Human Performance Visualization Correlations	Advance Multi-Role RPA Control Station Prototype



\$20 M/Yr

Human Performance Bioeffects CTC



Motivation

- **New threats:**
 - Lasers, radio frequency radiation and toxic compounds
 - Useful to Us (Weapons Effects)
 - Useful to Adversary (Protection)

Mission/Vision Statement

- **Protect against and exploit the bioeffects of battlefield environmental stressors**
 - Prevent mission degradation due to toxic exposure
 - Enable our forces to function safely, effectively and efficiently on the directed energy battlefield

Goals/Objectives

- **Determine human DE effects**
 - Offensive and Defensive
 - RF, Laser, Other Frequencies
 - Lethal and Non-lethal
 - Direct, Collateral, fratricide
- **Determine toxicology to new and developing materials and technologies**

Technical Approach/Ideas

- **Characterize behavioral & physiological response of individuals in response to high average power (HAP) & high peak power (HPP) RF systems**
- **Developing physics-based, high fidelity models to accurately predict damage or injury**
- **End-to-end design and prototyping of LEP for customized protection, compatible with avionics, and protective and aircrew flight equipment**
- **In Vitro, In Vivo and In Silico methods to assess toxicity**
- **Novel inhalation systems to address relevant AF exposures**





Human Performance Bioeffects CTC



Near-Term (FY14-16)	Mid-Term (FY17-19)	Far-Term (FY20 ->)
Jet Fuel Hearing Loss	Polyalphaolefin Coolant Toxicity Characterization	F-22/F-35 Hydraulic Fluid Toxicity Characterization
F-22/F-35 Multi-Chemical Exposure Study	Hex-Chrome Study	Heavy Metal Toxicity Characterization
Terahertz Molecular Interactions	Directed Energy Bioeffects Characterization	Directed Energy Tissue Interactions
High Energy Laser Range Safety Tools	Nanomaterial Bioeffects	Directed Energy Decision Support Tools for Fire Control
Visor Laser Eye Protection	Visor Laser Eye Protection	RF Bio Models for Weapon Optimization



Human Performance - Summary



- **Human Performance Mission:**
 - Develop human-centered science and technology research to optimize and protect the Airman's capabilities to fly, fight, and win in air, space, and cyberspace
- **Human Performance Technology Vision:**
 - *Lead the Air Force in Human-Centered Research.*
- **FY14 Investment: \$60M**

POC: Mr. Maris Vikmanis, 711HPW/RH

(937) 656-5491

maris.vikmanis@wpafb.af.mil