Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	93.954	93.527	87.452	0.000	87.452	89.331	89.185	92.014	93.763	Continuing	Continuing
621123: *Learning and Organizational Collaboration*	20.191	19.853	13.214	0.000	13.214	14.193	14.351	14.236	14.116	Continuing	Continuing
625328: *Human Dynamics Evaluation*	0.000	18.203	16.587	0.000	16.587	15.578	15.224	18.748	19.110	Continuing	Continuing
625329: *Sensory Evaluation and Decision Science*	0.000	21.910	22.492	0.000	22.492	24.166	24.345	24.555	25.317	Continuing	Continuing
627184: *Performance Evaluation in Extreme Environments*	54.937	18.486	18.436	0.000	18.436	17.765	17.715	16.318	16.623	Continuing	Continuing
627757: *Directed Energy Bioeffects*	18.826	15.075	16.723	0.000	16.723	17.629	17.550	18.157	18.597	Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328; Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329; and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This program conducts applied research on Airmen training, Airmen system interfaces, directed energy bioeffects, deployment and sustainment of Airmen in extreme environments, and understanding and shaping adversarial behavior. The Learning and Organizational Collaboration project conducts research to measure, accelerate, and expand the cognitive skills necessary to improve Airmen training and mission performance. The Human Dynamics Evaluation project conducts research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. The Sensory Evaluation and Decision Science project conducts research to revolutionize the manner in which the human optimizes the capabilities of Air Force systems, including autonomous unmanned aerial systems (UAS) and adaptive teams of humans and machines. The Performance Evaluation in Extreme Environments project conducts research to enhance human sensory, cognitive, and physical capabilities to increase Airmen survivability and performance. The Directed Energy Bioeffects project conducts research on the effects of human exposure to electromagnetic energy (radio frequency to optical), scalable directed energy weapons, and non-lethal weapons. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602202F: *Human Effectiveness Applied Research*

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	93.222	85.122	0.000	0.000	0.000
Current President's Budget	93.954	93.527	87.452	0.000	87.452
Total Adjustments	0.732	8.405	87.452	0.000	87.452
• Congressional General Reductions		0.000			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.395			
• Congressional Adds		8.800			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.732	0.000	87.452	0.000	87.452

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 621123: *Learning and Organizational Collaboration*		
Congressional Add: *Component Object Model (COM) Attitude Control System Simulation/Trainer.*	1.596	0.000
Congressional Add: *Ultra High Resolution Deployable Projector for Simulation.*	3.191	0.000
Congressional Add: *Center for Unmanned Aerial System (UAS) Research, Education and Training.*	0.000	6.373
Congressional Add Subtotals for Project: 621123	4.787	6.373
Project: 625329: *Sensory Evaluation and Decision Science*		
Congressional Add: *Advanced Night Vision System - Cockpit Integration.*	0.000	0.797
Congressional Add Subtotals for Project: 625329	0.000	0.797
Project: 627184: *Performance Evaluation in Extreme Environments*		
Congressional Add: *Imaging Tools for Human Performance Enhancement and Diagnostics.*	1.995	1.593
Congressional Add: *Homeland Emergency Learning and Preparedness (HELP) Center.*	2.992	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Air Force	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602202F: *Human Effectiveness Applied Research*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Congressional Add: *Smart View Program (SVP).*	0.798	0.000
Congressional Add: *Tools and Technologies for Incident and Consequence Management.*	0.798	0.000
Congressional Add Subtotals for Project: 627184	6.583	1.593
Congressional Add Totals for all Projects	11.370	8.763

Change Summary Explanation

The FY 2010 President's Budget submittal did not reflect FY 2011 through FY 2015 funding. A detailed explanation of changes between the two budget positions is not provided because it cannot be made in a relevant manner.

In FY 2010, Congress added $6.4 million for Center for Unmanned Aerial System (UAS) Research, Education and Training, $0.8 million for Advanced Night Vision System - Cockpit Integration, and $1.6 million for Imaging Tools for Human Performance Enhancement.

C. Performance Metrics
Under Development.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Organizational Collaboration*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
621123: *Learning and Organizational Collaboration*	20.191	19.853	13.214	0.000	13.214	14.193	14.351	14.236	14.116	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts applied research to measure, accelerate, and expand the cognitive skills necessary to improve Airmen training and mission performance. Research is conducted in three focus areas: immersive environments; continuous learning and aiding; and cognitive and behavioral modeling. The immersive environments effort creates live, virtual, and constructive (LVC) decision-making environments for use in developing revolutionary simulation technologies to increase training capabilities. Continuous learning and aiding enhances training effectiveness and efficiency by using learning theory to improve military training and mission performance. Cognitive and behavioral modeling creates realistic models and simulations of human behavior to advance the understanding of how people perform complex tasks.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Research enhances Distributed Mission Operations (DMO) and decision dominance environments; identifies requirements for aircrew training in live, immersive environments.	2.060	4.264	4.094	0.000	4.094
FY 2009 Accomplishments: In FY 2009: Performed human factors analyses, tests, and evaluations of visual and sensor simulation components for air-to-ground and air-to-air composite force training using air-to-surface operational testbed. Conducted perceptual evaluations of compact immersive display concepts and components. Transitioned results to address broader range of AF mission areas and initiated research on sensory-driven decision making in complex environments.					
FY 2010 Plans: In FY 2010: Research training and rehearsal issues for helmet cueing and targeting pod simulation systems that will allow for greater realistic composite force training. Expand sensory-driven modeling efforts to predict targeting pod performance and investigate how neural-sensory measurements					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Organizational Collaboration*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
correlate with model predictions. Define sensory requirements for a fully immersive collaborative training environment for DMO. Assess modeling and simulation requirements for intelligent threat models to support immersive training. Conduct research for the capabilities needed for a full-threat reaction trainer system. Enhance training capabilities by populating DMO databases with robust 3-D cultural content and correlated sensor attribution. NOTE: Increase in funding in FY 2010 is due to increased emphasis in this area. *FY 2011 Base Plans:* In FY 2011: Complete analysis of simulation requirements for air-to-ground and air-to-air force training. Utilize results to address specific training requirements for current and future AF fighter platforms. Apply sensory-driven decision-making models to broader range of AF mission areas. Evaluate analysis of modeling and simulation efforts for enhanced training. Complete evaluation of real-time data insertion capabilities into DMO. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Continuous learning/aiding strategies to improve personnel selection, mission training, command/control, intel, surveillance, and reconnaissance (ISR), unmanned and cyber missions. *FY 2009 Accomplishments:* In FY 2009: Developed tools to permit AF planners and managers to integrate competency-based methods into readiness parameters and assessment in operational training, rehearsal, and exercise. Identified alternative approaches for evaluating the individual, team, and team of team (coalition) performance impacts of collaborative, distributed spin-up training and rehearsal. Evaluated integrated instructional development and management methods for continuous learning in LVC contexts and explored task allocation methods for performance aiding and training in operational contexts. Identified functional requirements for instructor operator station capabilities. Investigated and evaluated physics-based directed energy threat models for DMO systems. Defined improved rule	9.278	5.695	5.785	0.000	5.785

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Organizational Collaboration*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
sets to enhance training utility of computer-generated forces. Assessed feasibility of enhanced threat avoidance and rehearsal training combining selected aerodynamic models, directed energy models, and validated visual special effects. *FY 2010 Plans:* In FY 2010: Develop methods for identifying common knowledge, skill, and experience requirements for individuals, teams, and teams-of-teams in manned and unmanned aerospace environments. Develop methods for adapting learning and performance environments to support individual and team training within and across AF and coalition mission areas. Develop tools for routinely tracking and storing experience and performance based on operational activities and training events. Explore methods that permit persistent learning within and across aerospace operational training, rehearsal, exercise, test, and evaluation contexts. Evaluate alternative approaches for training in LVC environments and across tactical, operational, and strategic levels of decision making. NOTE: Decrease in funding in FY 2010 is due to decreased emphasis in this area. *FY 2011 Base Plans:* In FY 2011: Validate methods for identifying common learning requirements for teams. Validate adaptation methods that function in both learning and operational environments and at the coalition level of interaction. Develop and evaluate alternative approaches to model human performance. Develop alternative data aggregation and reporting methods for analyzing mission performance and use these methods to enhance personnel selection, learning, and training. Evaluate these alternative methods for their effectiveness in supporting adaptive readiness training for individuals, teams, and teams-of teams. Begin validating approaches for LVC training and performance across tactical, operational, and strategic contexts. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
	4.066	3.521	3.335	0.000	3.335

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Cognitive/behavioral modeling explores application of cognitive science for performance improvement by enhancing training in mission-relevant environments (e.g. flight simulators). *FY 2009 Accomplishments:* In FY 2009: Expanded the breadth of the communication model to support end-to-end language processing. Integrated knowledge and skill tracking prediction system with mission essential competencies to predict training requirements for Airmen and demonstrated the ability to produce individualized training programs. Conducted empirical study with skill acquisition/retention models. Validated semi-automated, adaptive parameter search and model optimization capability and implemented graphical user interface for performance moderator prediction system. *FY 2010 Plans:* In FY 2010: Create adaptive language comprehension and generation capability for computer-generated communication models. Continue to integrate knowledge and skill tracking prediction system with mission essential competencies to predict individualized, optimized training requirements for Airmen. Broaden ability to model and predict individual differences in trainee susceptibility to cognitive fatigue across multiple tasks. *FY 2011 Base Plans:* In FY 2011: Integrate mission-relevant task model with language comprehension and generation capability to improve situational awareness of computer-generated teammates. Conduct empirical studies with skill acquisition/retention models and demonstrate ability to produce optimized training and rehearsal programs. Develop graphical user interface for performance prediction systems. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
Accomplishments/Planned Programs Subtotals	15.404	13.480	13.214	0.000	13.214

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Organizational Collaboration*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Add: Component Object Model (COM) Attitude Control System Simulation/Trainer. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for COM Attitude Control System Simulation/ Trainer. *FY 2010 Plans:* In FY 2010: Not Applicable.	1.596	0.000
Congressional Add: Ultra High Resolution Deployable Projector for Simulation. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Ultra High Resolution Deployable Projector for Simulation. *FY 2010 Plans:* In FY 2010: Not Applicable.	3.191	0.000
Congressional Add: Center for Unmanned Aerial System (UAS) Research, Education and Training. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct Congressionally-directed effort for a Center for UAS Research, Education and Training.	0.000	6.373
Congressional Adds Subtotals	4.787	6.373

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 621123: *Learning and Organizational Collaboration*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE 0602233N: *Human Systems Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602716A: *Human Factors Engineering Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602785A: *Personnel Performance and Training Technologies.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603231F: *Crew Systems and Personnel Protection Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603456F: *Human Effectiveness Adv Tech Dev.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0604227F: *Distributed Mission Training (DMT).*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625328: *Human Dynamics Evaluation*	0.000	18.203	16.587	0.000	16.587	15.578	15.224	18.748	19.110	Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to advance information operations and intelligence operator-aiding technologies by developing and applying human-focused research to create and influence behavior signatures of existing and emerging adversaries. Research will be in six focus areas: mission-essential human capabilities for air, space, and cyber operations; enhancing human components of intelligence, surveillance, and reconnaissance (ISR); anticipatory command, control, and intelligence (C2I); adversarial modeling and cross-cultural communication; predicting and evaluating organizational effectiveness alignment and collaboration readiness; and electromagnetic theory. These focus areas will enhance capabilities in layered sensing, decision aids for computer network attack/defense/survive, and human-centric exploitation of measurement and signatures intelligence.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Identify methods to enhance mission-essential human capabilities for cyber operations. Develop measures of effectiveness for cyber capabilities. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct research to enhance performance and increase situational awareness within cyber operations, including operations support center environments. Develop the operator's ability to anticipate and influence the behavior of adversaries. Conduct foundational studies toward enhancing cognitive cyber performance.	0.000	6.104	3.971	0.000	3.971

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Continue conducting research to enhance performance and increase situational awareness within cyber operations, including operations support center environments. Develop quantifiable measures of effectiveness to demonstrate ability to effectively anticipate and influence the behavior of adversaries. Continue foundational studies toward enhancing cognitive cyber performance. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Conduct research to enhance human components of ISR. Develop ability to anticipate, influence, and dominate adversary's air, space, and cyber ISR systems, processes, and organizations. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct cognitive task analysis and cognitive systems engineering to develop new intelligence analyst tools, training, and methods to establish and demonstrate dynamic command and control of air, space, and cyber ISR collection capabilities. Specific ISR capability objectives include universal situational awareness, dynamic control of ISR planning, workload reduction, and multi-source/multi-intelligence collaboration. *FY 2011 Base Plans:* In FY 2011: Conduct research to enable human operators to maximize utility of multi-sensor ISR systems in planning for dynamic situations. Conduct research to develop distributed, collaborative ISR dynamic planning capabilities for intelligence analysts.	0.000	1.593	2.518	0.000	2.518

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A					
MAJOR THRUST: Conduct research to develop technology base for anticipatory C2I decision support environment using past and present battlefield mission states to predict adversarial intent and actions. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Refine knowledge of representation techniques to model potential adversarial behavior and complex systems of systems and begin integrating information within visual displays. Research integrated set of work aids to achieve persistent operational planning, persistent prediction, and focused execution. Develop aids to enhance understanding of underlying C2I models and algorithms. *FY 2011 Base Plans:* In FY 2011: Research ability of models to simulate enemy potential courses of action, including complex adversarial behavior. Explore the feasibility to integrate models within visual displays. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A	0.000	2.241	1.368	0.000	1.368
MAJOR THRUST: Conduct research in adversarial modeling, cross-cultural communication, and automated speech translation tools for AF missions. *FY 2009 Accomplishments:* In FY 2009: Not Applicable.	0.000	6.111	6.683	0.000	6.683

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Conduct research to develop behavioral modeling techniques to gauge adversarial threats. Develop measures of effectiveness for selected influence operations capabilities. Develop speech-to-speech translation tools that support automated, cross-cultural communications. *FY 2011 Base Plans:* In FY 2011: Develop adversarial cultural modeling techniques to gauge adversarial threats. Develop advanced models/simulation to demonstrate measures of effectiveness for selected influence operations capabilities. Research foreign language speech-to-speech translation applications that support automated, cross-cultural communications. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop models/metrics to predict/evaluate organizational effectiveness alignment and collaboration readiness. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Identify organizational vulnerabilities at the structure, organizational culture, process, or human operator levels. Focus on exploitation of theories involving human trust in automation and interpersonal relationships to provide an understanding of how to influence systems with little to no degree of detection/suspicion among operators. Develop relevant organizational metrics, work design solutions, and simulation models to facilitate organizational effectiveness.	0.000	1.108	1.079	0.000	1.079

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Develop foundational decision aid concepts to exploit operator human-human trust and trust in automation for influence operators. Mature research on organizational effectiveness to support organizational change in government domains. Develop advanced models/simulations to show the impact of improved work design, engaged organizational culture, and enhanced collaboration readiness. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Conduct applied research in the areas of mathematics and electromagnetic theory to exploit/counter adversarial capabilities. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Conduct research on datasets from past/current influence operations. Continue anticipatory research designed to enhance blue force situational awareness of adversarial location and intent. *FY 2011 Base Plans:* In FY 2011: Refine advanced, automated algorithms for measures of effectiveness analyses supporting improved influence operations capabilities. Develop methods to enhance warfighter situational awareness of adversarial location and intent. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A	0.000	1.046	0.968	0.000	0.968
Accomplishments/Planned Programs Subtotals	0.000	18.203	16.587	0.000	16.587

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625328: *Human Dynamics Evaluation*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE 0603456F: *Human Effectiveness Adv Tech Dev.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
625329: *Sensory Evaluation and Decision Science*	0.000	21.910	22.492	0.000	22.492	24.166	24.345	24.555	25.317	Continuing	Continuing

Note

Note: In FY 2010, Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to revolutionize the manner in which the human optimizes the capabilities of AF systems, including autonomous unmanned aerial systems (UAS) and adaptive teams of humans and machines. Research optimizes situational awareness, improves the human-machine interface, and seamlessly integrates warfighters with their weapon systems across air, space, and cyber domains. Research is conducted in four focus areas: network-centric collaboration, supervisory control, battlespace visualization, and battlespace acoustics. The network-centric collaboration area develops warfighter interface technologies to enhance human-human and human-machine collaborations and system interactions in distributed decision-making environments. The supervisory control area develops new control/display concepts and technologies to optimize AF platform capabilities. The battlespace visualization area advances the science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. The battlespace acoustics area researches human-human and human-machine communications to exploit the use of voice and acoustic data in collaborative, net-centric environments while accounting for the effects of acoustic propagation.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develops warfighter interface technologies to enhance human-human and human-machine collaboration and system interaction in distributed decision-making environments.	0.000	4.996	4.881	0.000	4.881
FY 2009 Accomplishments: In FY 2009: Not Applicable.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Investigate individual and teams-of-teams performance metrics for team collaboration in a cross-domain distributed environment to include air, space, and cyber. Explore alternate human sensory technologies for operator functional state model development. Begin initial understanding of adaptive interface algorithms for individual operator decision aiding. *FY 2011 Base Plans:* In FY 2011: Investigate teams-of-teams performance metrics and begin to explore the nature of teams-of-teams cognitive workload so that future development of adaptive aiding algorithms shape team situational awareness in a network-centric environment. Investigate algorithms that assess team cognitive workload independent of the workload of individual operators. Begin to develop adaptive interface algorithms for operator decision aiding. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Researches new control/display concepts and technologies (e.g. information portrayal, control devices, and decision aiding algorithms). Identify best design to direct operator attention. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Design and evaluate advanced visualization concepts to support rapid situation assessment associated with switching tasks, interruptions, and unexpected state changes within multi-UAS control scenarios. Evaluate novel video exploitation aids to enable a single operator to monitor multiple video feeds. Compress critical net-centric and system information onto man-portable UAS interfaces in a manner that permits flexible, high-level tasking without undue workload. Identify	0.000	5.720	6.075	0.000	6.075

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 625329: *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
techniques that improve operator awareness of UAS automation mode and rationale for autonomous decisions. *FY 2011 Base Plans:* In FY 2011: Evaluate the utility of 3-D information displays, multi-sensory interfaces and other virtual reality technologies for multi-UAS supervisory control. Generate intuitive ways to monitor, interact, and coordinate with complex, intelligent UAS automation algorithms. Identify predictive information displays, including temporal displays that furnish proactive decision support to the human operator in multi-UAS scenarios. Investigate unique facets of automation, such as social attributes, that may improve the overall UAS human-system bandwidth. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Battlespace visualization advances science and technology associated with collecting, optimizing, displaying, and assimilating sensory information to enhance warfighter decision-making. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Explore vision enhancement techniques to increase rapid classification and identification for objects of interest in air, space, and cyber. Develop visualization technologies and interaction techniques for presenting complex information to enhance air, space, and cyber operations. Investigate presentation and interface technologies for enhancing space situational awareness. *FY 2011 Base Plans:* In FY 2011: Explore vision enhancement techniques that can support the air, space, and cyber analyst's ability to quickly categorize objects of interest. Perform laboratory evaluations of	0.000	5.877	6.162	0.000	6.162

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
visualizations that support human knowledge when presented with complex information in the air, space, and cyber domains. Develop visualizations and interaction techniques to exploit dynamic information. Develop situational awareness presentation and interface technologies that increase warfighter knowledge. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Conducts battlespace acoustics research on 3-D audio, active noise reduction, and technologies that mitigate effects of noise and enhances performance in operational environments. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Examine applications of how advanced multimodal interfaces can optimize distributed team performance in large-scale communication networks. Conduct research on network-based audio technologies for achieving shared situational awareness and exploiting information from multi-layered arrays of sensors in complex operational environments. Explore the use of persistent audio displays and other advanced auditory cueing techniques for continuously monitoring the status of complex UAS technologies. Conduct research on sensor systems and immersive display technologies for facilitating remote telepresence and optimizing the presentation of complex information in human-machine interfaces. *FY 2011 Base Plans:* In FY 2011: Evaluate the use of multimodal speech displays to optimize distributed team performance in large-scale communication networks. Conduct research on immersive audio and multimodal interfaces for exploiting large-scale networks of distributed information and enhancing real-time situational awareness and time-critical decision effectiveness. Explore integrated multi-sensory	0.000	4.520	5.374	0.000	5.374

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
display concepts to optimize the flow of information across distributed teams, emphasizing how intuitive displays can promote shared situational awareness between C2ISR assets and operators. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
Accomplishments/Planned Programs Subtotals	0.000	21.113	22.492	0.000	22.492

	FY 2009	FY 2010
Congressional Add: Advanced Night Vision System - Cockpit Integration. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Concuct Congressionaly-directed effort for Advanced Night Vision System - Cockpit Integration.	0.000	0.797
Congressional Adds Subtotals	0.000	0.797

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE 0603456F: *Human Effectiveness Adv Tech Dev.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602202F: *Human Effectiveness Applied Research*	**PROJECT** 625329: *Sensory Evaluation and Decision Science*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627184: *Performance Evaluation in Extreme Environments*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
627184: *Performance Evaluation in Extreme Environments*	54.937	18.486	18.436	0.000	18.436	17.765	17.715	16.318	16.623	Continuing	Continuing

Note

Note: In FY 2010, Human Dynamics Evaluation efforts will move from Project 7184 to Project 5328; Sensory Evaluation and Decision Science efforts will move from Project 7184 to Project 5329; and Performance Evaluation in Extreme Environments efforts within Project 7757 will move to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research to enhance human sensory, cognitive, and physical capabilities to increase Airmen survivability and performance. The research is focused in four areas: biobehavioral performance, biomechanics, applied biotechnology, counterproliferation. Both biobehavioral and biomechanics focus areas enhance Airmen performance and survivability through dynamic human modeling techniques that define the capabilities and limits of system operators under military-unique stressors, as well as assessing and identifying adversarial threats. Applied biotechnology advances bioscience, nanotoxicology, and neuroscience research to protect Airmen from the effects of toxic chemicals and materials, and to monitor and enhance cognitive and physiological performance. Counterproliferation research focuses on biotechnology for the detection, identification, monitoring, and neutralization of biological threat agents.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Develop interface technologies that enhance human-human and human-machine collaboration in network-centric warfare environments.	4.896	0.000	0.000	0.000	0.000
FY 2009 Accomplishments: In FY 2009: Explored the use of transparent multilingual collaboration tools for distributed multi-entity teaming. Developed multinational speech translation technologies for obscure languages. Determined the effects of collaboration technologies on performance efficiency, shared situational awareness, workload and decision making for tactical command and control. Began development of adaptive automated human-machine interfaces to improve real-time human-machine task sharing. Developed predictive operator state models and assessment tools for dynamic workflow and workload					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
management. NOTE: In FY 2010, efforts from this major thrust will move to Project 5328 and Project 5329 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop cognitive system interface technologies to achieve common understanding at all echelons of operations and to improve decision-making and predictive battlespace awareness. *FY 2009 Accomplishments:* In FY 2009: Expanded contents of DoD software design patterns library. Embedded design patterns in graphical user interface building tools. Demonstrated collaboration techniques in a distributed net-centric environment. Investigated how collaboration techniques can enable distributed team self-synchronization. Researched the cultural and ethnic bases of human decision making and developed human performance models that reflect cultural differences to enable effects-based operations. NOTE: In FY 2010, efforts from this major thrust will move to Project 5328 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable.	4.296	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A					
MAJOR THRUST: Establish technology base for decision support environment that enables interrelation of past, present, and future battlefield missions and to predict the intent/actions of adversaries. *FY 2009 Accomplishments:* In FY 2009: Analyzed the results of the initial demonstration of the integration of the displays and technologies. Completed the transition of advanced uncertainty visualization techniques for command center display. Transitioned methods needed to simulate enemy potential courses of action, including more complex adversary behavior. Incorporated more extrapolated “sensemaking” results into displays. Refined the knowledge representation techniques to model potential adversaries and complex systems of systems and began integrating into displays. Transitioned the integrated set of anticipatory planning and operations work aids to achieve persistent operational planning, persistent prediction, and focused execution and evaluated the effect. Conducted follow-on demonstration of the integration of the developed displays and technologies. NOTE: In FY 2010, efforts from this major thrust will move to Project 5328 and Project 5329 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A	2.192	0.000	0.000	0.000	0.000
MAJOR THRUST: Develop system control interface concepts enabling operator exploitation of AF platform capabilities. Identify best mix of methods/traditional design to direct operator's attention.	4.423	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Integrated real-time assessment tools into second generation control-display operator workstations to optimize operator task loading and avoid channelized attention. Used second generation operator workstations during field testing and flight demonstration to control multiple, highly autonomous UAVs. Began software design and development of common interface and software architectures of control-display concepts that allow minimal numbers of operators to control autonomous UAVs in urban environments and/or in large-scale, strategic military operations. NOTE: In FY 2010, this major thrust will move to 5329 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop/evaluate algorithms to enhance visual input through fusion of multispectral sensors, digital image processing, and solid-state display technologies to enhance real-time imaging. *FY 2009 Accomplishments:* In FY 2009: Performed multispectral, real-time field evaluations of display algorithm sets that have been optimized for different tactical scenarios. Refined information portrayal and interaction techniques to enhance decision-making by testing more intuitive visualizations and user interfaces. Tested these methods against current state-of-the-art to prove and improve total system effectiveness. Began to develop visualization technologies that enhance cyberspace understanding in command centers. NOTE: In FY 2010, this major thrust will move to 5329 to better align efforts.	4.515	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop advanced audio display technologies for human-to-human collaboration including 3-D audio and active noise reduction to enhance performance/information processing. *FY 2009 Accomplishments:* In FY 2009: Developed acoustic aiding for urban operations to improve machine-to-human communications by using ultrasonic and laser technology advances to improve security forces' information gathering. Explored methods and developed models to predict acoustic detectability under dynamic conditions for improved offensive operations. Developed auditory information-aiding technologies for remote collaboration by exploiting advances in communication theory for individuals. Explored the individual and group processes that lead to communication breakdown. Improved auditory sensing technology to create virtual auditory reality for human interface to remote sensing, emphasizing its application to security forces. NOTE: In FY 2010, this major thrust will move to 5329 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable.	3.749	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A					
MAJOR THRUST: Develop human-centered Information/Cyber Operation and ISR technologies to provide quicker/more intuitive access to information, enhanced decision-making capabilities and improved tools. *FY 2009 Accomplishments:* In FY 2009: Developed and validated advanced IO/Influence Operations research tools and training techniques to enable increased offensive and defensive combat capabilities which counter asymmetric adversarial threats. Validated and completed IO/Influence Operations models and simulation capabilities. Developed and validated prototype of advanced speech-to-speech translation tool. Developed capability to anticipate adversarial behavior, both individually and in group, with application in the psychological operations domain. Investigated methods to enhance human ability to uncover concealed information. Developed collaborative tools and training for ISR team applications with emphasis on distributed operations. NOTE: In FY 2010, this major thrust will move to 5328 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A	11.672	0.000	0.000	0.000	0.000
MAJOR THRUST: Develop databases from air/space sensors of human motion, actions, and features across diverse populations and integrate with ISR technologies to identify threats to military personnel.	4.603	4.484	4.873	0.000	4.873

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Optimized equipment technologies, refined procedures, and improved training processes to address the most common AF job-related injuries and disabilities. Extended these improvements to not only prevent injuries but also to optimize human performance. Developed workstation design criteria to maximize operator performance and minimize fatigue, based on interrelationships between equipment fit, workload, anthropometry, physical capability, and cognitive capability. Used biomechanics collaborative information technologies to collect and analyze data to protect forces against threats in hostile environments. *FY 2010 Plans:* In FY 2010: Use principles of biomechanics to analyze behavioral data. Collect motion data and develop initial analysis techniques to identify behaviors that seem out-of-context. Include cultural information to develop physical behavior signatures. Integrate information from multiple sensors to help identify a human threat. *FY 2011 Base Plans:* In FY 2011: Complete development and validate techniques to identify human motions that seem out-of-context. Use these techniques to collect and analyze motion data to study expressions and behaviors. Develop models that include cultural information to detect anomalies in both behavior and expressions. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Quantify and model operator performance in stressful environments and develop technologies to mitigate effects of stressors on cognitive function, safety, and mission effectiveness.	1.044	2.722	3.055	0.000	3.055

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: In FY 2009: Conducted behavioral neuroscience research to characterize and mitigate human cognitive degradation during demanding military operations. Refined real-time biobehavioral performance monitoring technology and developed operational employment concepts. Investigated cognitive disruption technologies and potential countermeasures. *FY 2010 Plans:* In FY 2010: Use performance databases to refine warfighter physical training programs with the goal of improving retention and operational performance. Conduct research integrating behavioral psychology and metabolomic research to enhance human performance in multiple stressor environments. NOTE: In FY 2010, this effort merges with major thrust from Project 7757 to better align efforts. *FY 2011 Base Plans:* In FY 2011: Use anthropometry data to develop techniques to improve battlefield airmen physical performance. Begin development of models to optimize warfighter cognitive and physical performance. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop, demonstrate, and apply experimental models for predicting toxicological compromises and to assure protection of AF personnel from toxic hazards and exposures. *FY 2009 Accomplishments:* In FY 2009: Developed procedures and computer simulation models to predict effects of toxic compound and nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using computer modeling and systems biology approaches to understand functional cellular dynamics and	1.901	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
engineering, explored and created integrated new sensor and material constructs for AF applications. NOTE: In FY 2010, this effort is combined with the next major thrust to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Conduct bio/nanotechnology research to advance warfighter performance. Leverage toxicological/biological data to improve human performance and decision-making abilities. *FY 2009 Accomplishments:* In FY 2009: Completed genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure in deployed Airmen. Investigated connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel. *FY 2010 Plans:* In FY 2010: Conduct research to identify and validate biomarkers relevant to cognitive and physiological changes that enhance human performance. Conduct analysis of novel AF nanomaterial toxicity. Define cell-based pathway engineering for biosensors of human performance. *FY 2011 Base Plans:* In FY 2011: Conduct research to identify and validate biomarkers relevant to cognitive and physiological changes that enhance cognition and optimize performance in training. Complete studies in nanomaterial toxicity. Demonstrate cell-based pathways for layered-sensor integration.	3.758	4.793	5.201	0.000	5.201

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 OCO Plans: In FY 2011 OCO: N/A					
MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-scale advanced technology development programs. *FY 2009 Accomplishments:* In FY 2009: Explored and applied integrated, multifunction job aiding concepts in laboratory and controlled field tests. Investigated the usefulness of collaboration support for troubleshooting and complex field repair problems. Explored the hardware, software, and packaging issues for combined job aid and on-the-job training devices for maintenance work. NOTE: In FY 2009, this effort is terminated due to higher AF priorities. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A	1.305	0.000	0.000	0.000	0.000
MAJOR THRUST: Conduct counterproliferation research to support detection, identification, neutralization, and assessment of threat agents and provide information for air operations. *FY 2009 Accomplishments:* In FY 2009: Not Applicable.	0.000	4.894	5.307	0.000	5.307

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Conduct research to develop nanoparticle taggants for line-of-sight, standoff assessment of preemptive airstrike destruction of biological warfare agents. Define preliminary techniques to effectively neutralize genetically-modified biological threat agents. Perform initial research to anticipate impacts of high threat environments on air operations and to provide post-attack situational awareness. NOTE: In FY 2010, this major thrust will move from Project 7757 to better align efforts. *FY 2011 Base Plans:* In FY 2011: Expand and refine nanoparticle taggants for line-of-sight, standoff assessment of preemptive destruction of biological warfare agents. Develop technologies to neutralize genetically modified biological threat agents. Develop technologies to anticipate high threat environments on air operations and to provide post-attack situational awareness. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
Accomplishments/Planned Programs Subtotals	48.354	16.893	18.436	0.000	18.436

	FY 2009	FY 2010
Congressional Add: Imaging Tools for Human Performance Enhancement and Diagnostics. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Imaging Tools for Human Performance Enhancement and Diagnostics.	1.995	1.593

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2010 Plans: In FY 2010: Conduct Congressionally-directed effort for Imaging Tools for Human Performance Enhancement and Diagnostics.		
Congressional Add: Homeland Emergency Learning and Preparedness (HELP) Center. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for HELP Center. *FY 2010 Plans:* In FY 2010: Not Applicable.	2.992	0.000
Congressional Add: Smart View Program (SVP). *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for SVP. *FY 2010 Plans:* In FY 2010: Not Applicable.	0.798	0.000
Congressional Add: Tools and Technologies for Incident and Consequence Management. *FY 2009 Accomplishments:* In FY 2009: Conducted Congressionally-directed effort for Tools and Technologies for Incident and Consequence Management. *FY 2010 Plans:* In FY 2010: Not Applicable.	0.798	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Adds Subtotals	6.583	1.593

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE 0602201F: *Aerospace Flight Dynamics.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602204F: *Aerospace Sensors.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0602702F: *Command, Control, and Communications.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603205F: *Flight Vehicle Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603231F: *Crew Systems and Personnel Protection Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603245F: *Flight Vehicle Technology Integration.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603456F: *Human Effectiveness Adv Tech Dev.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0604706F: *Life Support Systems.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Air Force			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602202F: *Human Effectiveness Applied Research*	PROJECT 627757: *Directed Energy Bioeffects*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
627757: *Directed Energy Bioeffects*	18.826	15.075	16.723	0.000	16.723	17.629	17.550	18.157	18.597	Continuing	Continuing

Note

Note: In FY 2010, Performance Evaluation in Extreme Environments efforts will move from Project 7757 to Project 7184 to better align efforts.

A. Mission Description and Budget Item Justification

This project conducts applied research on the effects of human exposure to electromagnetic energy (radio frequency to optical), scalable directed energy weapons, and non-lethal weapons. This research addresses fundamental physical principles as well as the psychophysical interaction between directed energy and the individual or groups of individuals. Research is divided into three core focus areas: optical radiation bioeffects, radio frequency radiation (RFR) bioeffects, and biobehavioral systems. Optical radiation bioeffects research enhances combat survivability and systems effectiveness through technologies that enable deployed forces to counter optical threats and exploit optical systems for offensive applications. The RFR bioeffects research focuses on theoretical and empirical dosimetry, bioeffects of short- and long-term exposure, methods to counter RFR threats, and exploitation of directed energy systems for offensive capabilities. Biobehavioral systems research concentrates on the design and characterization of scalable directed energy and novel-effects weapons, and their ability to modify human behavior.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
MAJOR THRUST: Conducts laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats.	6.606	7.497	8.186	0.000	8.186
FY 2009 Accomplishments: In FY 2009: Performed field and laboratory experiments to verify and validate optical physics model of bidirectional reflectivity distribution calculations for use as high energy laser collateral hazard assessment tool. Integrated collateral hazard assessment software model into airborne laser platform performing high energy laser system demonstrations. Initiated experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Evaluate collateral hazard assessment software model on high energy laser platforms and develop next generation of hazard assessment tools. Further expand laser damage threshold database for multiple wavelengths to validate DoD, national, and international safety standards. Evaluate superthreshold tissue impacts and further define weapon effectiveness parameters. Conduct experiments for future high energy laser weapon systems to predict, evaluate, and explore target bioeffects. *FY 2011 Base Plans:* In FY 2011: Conduct research to refine DoD, national, and international safe exposure standards to include multiple wavelength laser exposures. Initiate research to provide personal protection while operating in a high energy directed energy weapon hazard zones. Validate collateral hazard assessment software for high energy laser systems and weapon platforms. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Conducts laboratory experiments and field research to enable safe exploitation of directed energy technologies for communication, target identification, and weapons development. *FY 2009 Accomplishments:* In FY 2009: Conducted experiments to refine and eliminate gaps in RFR exposure standards for microwave, ultra-wide band, high peak power RFR systems, and terahertz frequency ranges. Integrated and improved human behavior, bioeffects, and target effects computer models based on RFR studies in microwave, ultra-wide band, high peak power, and terahertz sources. Investigated RFR bioeffects as a foundation for future RFR weapons.	6.481	7.185	8.136	0.000	8.136

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: In FY 2010: Evaluate biological responses to high power and high peak power EM systems from cellular to whole organism perspectives. Validate models of RFR bioeffects through laboratory and field experimentation, as well as applied mathematics. Conduct research to support fielding and effectiveness of scalable directed energy weapon systems. Conduct research into the bioeffects and safety of terahertz sources. *FY 2011 Base Plans:* In FY 2011: Conduct terahertz research in order to refine national and international safe exposure levels and evaluate potential military utility. Conduct bioeffects research to support scalable directed energy weapon capabilities. Initiate development of a model of scalable RFR effects based on experimentation and theoretical physics. Assess combinations of directed energy parameters on behavior and physiology. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Concentrates on human responses to non-lethal weapons and conducts research to assess the effects and risk of these weapons. *FY 2009 Accomplishments:* In FY 2009: Not Applicable. *FY 2010 Plans:* In FY 2010: Develop initial quantitative models of behavioral responses to RFR non-lethal weapons. Develop Human Effect-Modeling Applications Program (HE-MAP) by incorporating a software interface that links graphical user interfaces with predictive models of RFR non-lethal weapon-induced effectiveness and risk. Incorporate within HE-MAP the development of a design optimization and effects-based module that will allow analysis of design parameters and their influence on	0.000	0.393	0.401	0.000	0.401

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
effectiveness. NOTE: In FY 2010, this effort is broken out from the previous major thrust to separate distinct technology areas. *FY 2011 Base Plans:* In FY 2011: Develop initial quantitative models of behavioral responses using effects data from directed energy non-lethal weapons. Enhance HE-MAP through addition of a software interface linking HE-MAP graphical user interfaces with predictive models of acoustic non-lethal weapon-induced effectiveness and risk. Incorporate within HE-MAP the development of an effects-based design module that will allow analysis of design parameters of directed energy non-lethal weapons and their influence on effectiveness. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop biotechnologies to support detection, neutralization, and assessment of threat agents. Perform counterproliferation research to enable operations in high threat environments. *FY 2009 Accomplishments:* In FY 2009: Refined viability assessment technologies and developed models that predict plume distribution patterns to minimize collateral damage from counterforce weapon detonations. Developed advanced biological taggant technologies that will locate biological warfare agents behind walls and in containers. Investigated counterproliferation technologies capable of effectively neutralizing genetically modified biological threat agents. NOTE: In FY 2010, this major thrust will move to Project 7184 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable.	3.709	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A					
MAJOR THRUST: Develop technology solutions integrating behavioral psychology, metabolomic research, nutritional strategies, and personal protective technologies to optimize human performance. *FY 2009 Accomplishments:* In FY 2009: Developed and assessed benefit of tailored/agile human performance optimization regimens to confront asymmetric threats. Expanded biobehavioral performance models to incorporate individual differences in human performance vulnerability. NOTE: In FY 2010, this major thrust will move to Project 7184 to better align efforts. *FY 2010 Plans:* In FY 2010: Not Applicable. *FY 2011 Base Plans:* In FY 2011: Not Applicable. *FY 2011 OCO Plans:* In FY 2011 OCO: N/A	2.030	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	18.826	15.075	16.723	0.000	16.723

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C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• PE 0602720A: *Environmental Quality Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603231F: *Crew Systems and Personnel Protection Technology.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0603456F: *Human Effectiveness Adv Tech Dev.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0604617F: *Agile Combat Support.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
• PE 0604706F: *Life Support Systems.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

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