Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force											Date: March 2024	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	133.233	146.921	138.204	0.000	138.204	128.433	127.050	137.461	140.303	Continuing	Continuing
620200: *Enterprise Transformational Appld Research*	0.000	0.000	0.191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
621123: *Learning and Operational Readiness*	0.000	18.632	22.394	20.103	0.000	20.103	21.712	21.588	23.937	24.449	Continuing	Continuing
625328: *Biosciences Performance*	0.000	38.444	32.218	29.087	0.000	29.087	33.360	30.879	30.828	31.517	Continuing	Continuing
625329: *Warfighter Interfaces and Teaming*	0.000	35.346	44.454	42.884	0.000	42.884	43.981	44.533	49.415	50.391	Continuing	Continuing
627757: *Bioeffects*	0.000	40.811	47.664	46.130	0.000	46.130	29.380	30.050	33.281	33.946	Continuing	Continuing

Note

This program, BA 2, PE 0602202F, project 621123, Learning and Operational Training, is a new start.
This program, BA 2, PE 0602202F, project 621123, Digital Models of Cognition, is a new start.
This program, BA 2, PE 0602202F, project 625329, Human Machine Interactions, is a new start.
This program, BA 2, PE 0602202F, project 625329, Distributed Teaming and Communication, is a new start.

A. Mission Description and Budget Item Justification

This program conducts applied research in the area of airmen training, airmen performance sustainment, bioeffects, and understanding and shaping adversarial behavior. The Learning and Operational Readiness project conducts research to increase the agility of training for readiness while advancing learning and performance assessment science and practice. The Biosciences Performance project conducts research to discover, demonstrate, and transition capabilities which optimize and safe-guard Airman physical and cognitive performance allowing for the maximum potential of the multi-domain Airman. The Warfighter Interfaces and Teaming project conducts research to discover, develop, and transition advanced interface technology, decision aiding tools, and situationally-adaptive augmentation methods to seamlessly integrate Airmen and intelligent machines into maximally collaborative warfighting teams. The Bioeffects project conducts novel and operational exposure bioeffects research, exposure effects analysis and national/international exposure standards for the Air Force to enable, sustain, and enhance Airman performance and protection during deployment of directed energy systems.

This program element may include necessary expenses to support the operation and maintenance of facilities to manage, execute, and deliver science and technology capabilities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and technology capabilities. The use of program funds in this program element would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602020F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	150.771	146.921	141.651	0.000	141.651
Current President's Budget	133.233	146.921	138.204	0.000	138.204
Total Adjustments	-17.538	0.000	-3.447	0.000	-3.447
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-9.633	0.000			
• SBIR/STTR Transfer	-2.474	0.000			
• Other Adjustments	-5.431	0.000	-3.447	0.000	-3.447

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: 625328: *Biosciences Performance*		
Congressional Add: *Critical Air Transport Technology Expansion*	0.000	0.000
Congressional Add: *Advanced Warfighter Physiology and Operational Readiness*	4.000	0.000
Congressional Add: *Special Tactics Support Assessment*	4.000	0.000
Congressional Add Subtotals for Project: 625328	8.000	0.000
Congressional Add Totals for all Projects	8.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 620200 / *Enterprise Transformational Appld Research*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
620200: *Enterprise Transformational Appld Research*	0.000	0.000	0.191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element develops multidisciplinary applied research efforts to accelerate the technology pipeline of transformational capabilities by reducing risk and maturing the technology so it can transition in support of larger advanced technology development capability investments. These activities are selected to enable solutions to the DAFs highest priorities to include Operational Imperatives and Critical Technology Areas. The Explore effort engages traditional & nontraditional industry, government laboratories and academia through 12-24 month feasibility studies and demonstrations. The Seedlings for Disruptive Capabilities Program (SDCP) facilitates AFRL cross-disciplinary applied research to provide leap-ahead, high risk technology development. Modeling, simulation, and analyses activities will continue to explore transformational research analytic technologies to enable validated positions and provide a solid foundation with emphasis to predict future outcomes and technology needs, as well as looking for more seedlings to feed the transformational capability pipeline. Continue to advance future workforce development programs and broadening partnerships to deepen and expand the scientific and technology enterprise. Applied research efforts span a broad spectrum of activities, and established processes allow agility and flexibility to meet higher demand signals.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Enterprise Transformational Applied Research	0.000	0.191	0.000
Description: Enterprise Transformational Applied Research ***FY 2024 Plans:*** This work will be executed out of and described in the plans for Program PE 0602202F Enterprise Transformational Appld Research, Project 620200 Enterprise Transformational Appld Research effort. ***FY 2025 Plans:*** This work moved and is executed out of and described in the plans for Program PE 0602202F Enterprise Transformational Appld Research, Project 620200 Enterprise Transformational Appld Research effort. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased from FY 2024 by $0.191 million. This work moved and is executed out of and described in the plans for Program PE 0602202F Enterprise Transformational Appld Research, Project 620200 Enterprise Transformational Appld Research effort.			
Accomplishments/Planned Programs Subtotals	0.000	0.191	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 620200 / *Enterprise Transformational Appld Research*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 621123 / *Learning and Operational Readiness*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
621123: *Learning and Operational Readiness*	0.000	18.632	22.394	20.103	0.000	20.103	21.712	21.588	23.937	24.449	Continuing	Continuing

Note

This program, BA 2, PE 0602202F, project 621123, Learning and Operational Training, is a new start.
This program, BA 2, PE 0602202F, project 621123, Digital Models of Cognition, is a new start.

A. Mission Description and Budget Item Justification

This project enables decision superiority by advancing the science and technology of human multisensory perception, learning, information processing, and action. This project looks to establish a persistent, global experimentation, test, and training ecosystem that supports personalized, proficiency-based readiness for warfighters in joint all-domain operations. Using digital modeling advancements will be made with consideration of human perception, cognition, and action in system development, wargaming, and operational planning. Research is conducted in two focus areas: learning and operational training and digital models of cognition. Digital models of cognition focus on holistic models that support quantitative understanding and prediction of mission effectiveness. Learning and operational training improves learning and understanding in the context of evolving technology.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Personalized Learning	11.432	13.436	4.666
Description: Research lays the foundation for long-term Operational Training and Test Infrastructure by creating capabilities that enhance live-virtual-constructive environment and integration, exploring environments and mechanisms to enable collaborative learning in human-machine teams, researching individual and team measurement and assessment techniques, algorithms to enable a shift toward personalized and proficiency-based training and readiness management, and researching how advanced learning technologies like augmented and virtual reality can be used to increase the effectiveness and efficiency of training.			
FY 2024 Plans: Continue research evaluating integrated human and machine personalized learning capabilities in mission-relevant laboratory. Initiate research integrating multi-objective optimization and team proficiency assessment into a common ecosystem for synthetic operational training and testing. Initiate transition of proficiency measurement and prediction capabilities, including uncertainty quantification, to targeted domains such as language learning and recurring training areas. Continue research evaluating the impact of training fidelity related to augmented, virtual, mixed, and extended reality on readiness. Continue exploring methods and standards for assessing transfer of skill for just in time, novel mission training requirements for a peer fight in deployed and austere environments. Initiate mobile research platform for embedding in integrated training events for data collection			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 621123 / *Learning and Operational Readiness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
in controlled, naturalistic environment. Initiate mechanisms for co-learning in teams of humans and machines to maximize collaboration and performance in a laboratory setting. ***FY 2025 Plans:*** - Continue research evaluating integrated human and machine personalized learning capabilities in mission-relevant laboratory. - Continue research integrating multi-objective optimization and team proficiency assessment into a common ecosystem for synthetic operational training and testing. - Complete transition of proficiency measurement and prediction capabilities, including uncertainty quantification, to targeted domains such as language learning and recurring training areas. - Continue research evaluating the impact of training fidelity related to augmented, virtual, mixed, and extended reality on readiness. - Complete exploring methods and standards for assessing transfer of skill for just in time, novel mission training requirements for a peer fight in deployed and austere environments. - Complete mobile research platform for embedding in integrated training events for data collection in controlled, naturalistic environment. - Continue mechanisms for co-learning in teams of humans and machines to maximize collaboration and performance in a laboratory setting. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased from FY 2024 by $8.770 million. Funding decrease due to a reduced emphasis in proficiency measurement and prediction capabilities, transfer of skill in mission training, and mobile research platforms for integrated training events.			
Title: Learning and Operational Training ***Description:*** Research that emphasizes learning and understanding in the context of evolving technology. This includes research to establish an ecosystem that maximizes mission effectiveness while minimizing costs by matching technologies to learning and performance needs; targeted investments to develop, demonstrate, and transition learning methods and technologies matched to learner and performance needs; high resolution human and system measurement to enable quantitative, proficiency-centric readiness assessment and prediction at the individual and team levels; and exploration of mechanisms and theory of interactive learning and collaborative training of humans and Artificial Intelligence-enabled machines to support mutual adaptation and understanding that fosters uniquely effective human-autonomy teams. ***FY 2024 Plans:*** Not Applicable ***FY 2025 Plans:***	0.000	0.000	7.554

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 621123 / *Learning and Operational Readiness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate research on how to apply theories, methods, and studies to support just in time training to accelerate the acquisition of expertise and increase performance resilience. - Initiate definition data tools, analytics, schemes, and Models to enable training and readiness representations for digital engineering. - Initiate exploration and assessment of infrastructure needs to support training for a peer fight that enables the collection, contextualization, and application of data for performance assessment, readiness management, and personalization of competency-based instruction. - Initiate defining the methods and technologies to support the interactive learning between humans and AI-enabled technologies. - Initiate exploration and validation of adaptive team training paradigms with relevant test and evaluation approaches to ensure uniquely effective human-autonomy teams. - Initiate identification and validation of algorithms to shape flexible, adaptive, shared representations between teammates. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $7.554 million. Funding increase due to added emphasis in a new thrust area for adaptive team training paradigms to ensure uniquely effective human-autonomy teams, and the identification and validation of algorithms for teaming.			
Title: Cognitive Modeling	7.200	8.958	3.119
Description: Research explores application of mathematical and computational modeling to understand the human mind and factors that will enhance or degrade cognitive performance. Capabilities enable personalized learning by tracking individual learning and targeting training interventions where/when needed. Research also explores applications for computer-generated forces with greater cognitive fidelity improving realism while reducing manpower costs for large, simulated scenarios. Investigates algorithms that track and predict readiness and mission effectiveness based on influences of the mission context and individual stressors improving the fidelity of wargames, system development, and operational planning with better characterizations of human capital capacities and limitations. ***FY 2024 Plans:*** Initiate capability for real-time fatigue monitoring and prediction for mobility and maintainer community. Continue real-time, personalized tracking of fatigue in operationally relevant environments, including impacts of countermeasures. Complete integrated physiology cognitive models to oxygen deprivation and chemical air contaminants. Continue laboratory capability profile workload and cognitive performance in real-time, and assess and predict performance based on interacting effects of multiple cognitive modulators in a laboratory setting. Initiate research computational and mathematical frameworks for representing human performance across scales of analysis, components of cognition and performance, and levels of resolution for digital engineering applications. Initiate computational modeling capability for situational understanding through natural language interaction,			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 621123 / *Learning and Operational Readiness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
information extraction, and information seeking in a laboratory context. Initiate research to demonstrate autonomy-based dynamic task allocation based on operator workload with context sensitivity. ***FY 2025 Plans:*** - Complete capability for real-time fatigue monitoring and prediction for mobility and maintainer community. - Complete real-time, personalized tracking of fatigue in operationally relevant environments, including impacts of countermeasures. - Complete laboratory capability profile workload and cognitive performance in real-time, and assess and predict performance based on interacting effects of multiple cognitive modulators in a laboratory setting. - Continue research computational and mathematical frameworks for representing human performance across scales of analysis, components of cognition and performance, and levels of resolution for digital engineering applications. - Continue computational modeling capability for situational understanding through natural language interaction, information extraction, and information seeking in a laboratory context. - Continue research to demonstrate autonomy-based dynamic task allocation based on operator workload with context sensitivity. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $5.839 million. Funding decrease due to a reduced emphasis in real-time fatigue monitoring, personalized fatigue tracking, and workload and cognitive performance predictions from multiple cognitive modulators.			
Title: Digital Models of Cognition ***Description:*** Research to identify computational and mathematical mechanisms to represent human perception, information processing, and behavior, including the integration of models that reflect the role of internal and external factors that modulate performance efficiency and effectiveness. Research area develops models of cognitive systems that support quantitative understanding and prediction of mission effectiveness for decision superiority. Develops analytic methods, models, and tradecraft that enables operators to improve Information-Related Capability. ***FY 2024 Plans:*** Not Applicable ***FY 2025 Plans:*** - Initiate computational cognitive modeling to enable quantitative understanding and prediction of mission effectiveness in the context of controlling crewed aircraft and Collaborative Combat Aircraft within the Next Generation Air Dominance family of systems for decision superiority. - Initiate experimentation on digital models that account for internal and external factors that modulate cognitive performance efficiency and effectiveness within tactical environments.	0.000	0.000	4.764

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 621123 / *Learning and Operational Readiness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate research to define descriptive and anticipatory analytics that derive from network and content data to inform assessment and decision making re: information maneuvers and strategies. - Initiate experimentation to examine the underlying psychological mechanisms of influence and test methods to build resilience. - Initiate research to create digital models to examine different social dynamics and features that impact individual and group cognition. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $4.764 million. Funding increase due to added emphasis in a new thrust area for psychological mechanisms of influence and test methods to build resilience, and digital models to examine different social dynamics and features that impact individual and group cognition.			
Accomplishments/Planned Programs Subtotals	18.632	22.394	20.103

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

None

D. Acquisition Strategy

Not Applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 625328 / *Biosciences Performance*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
625328: *Biosciences Performance*	0.000	38.444	32.218	29.087	0.000	29.087	33.360	30.879	30.828	31.517	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts bioengineering and biotechnology research to optimize, safe-guard, and restore the performance of the multi-domain Airman in all environments. Research is focused in the areas of 1) Applied Cognitive Neurosciences: technologies to sustain, augment, and recover operator performance; 2) Biotechnology for performance: research in systems biology, synthetic biology, and risk assessment; 3) Performance sensing and assessment: technologies to sense and forecast operator state based on physiological, molecular, and environmental signatures related to mission performance; and 4) Performance impact of flight: elucidate how air environments affect processes of life and the ability to maintain physiological equilibrium and develop countermeasures and solutions to sustain, enhance, and restore operator performance.

In FY 2025 Project 625328 Biosciences Performance, changed from Human Dynamics Evaluation.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Performance Sensing and Assessment	7.611	6.444	5.675
Description: Develop technologies to sense and forecast operator state based on physiological, molecular, and environmental signatures related to Airman performance. Develop solutions optimized for real-time, minimally-invasive, and autonomous sensing and assessing capabilities to enhance and protect the Airman across the spectrum of operational environments. In FY 2023, this effort changed names from Molecular Sensing and Physiology to Performance Sensing and Assessment. ***FY 2024 Plans:*** Continue rapid Biological Recognition Element selection and optimization strategies. Continue electrochemical and Field Effect Transistors-based biomarker sensing platforms, including synthetic biology developed components. Complete sensor form factor for deployment with focus on platform miniaturization. Complete wearable and implantable/biodegradable sensors for continuous biomarker monitoring. Complete platforms to deliver augmentation strategies in an autonomous fashion. Complete the evaluation of commercial, off-the-shelf molecular-based sensing technologies for Air Force and Space Force applications. Initiate the identification and optimize bio-molecular mechanisms to sense cognitive function, performance, fatigue, and stress in console operators (i.e. Intelligence, Surveillance, Reconnaissance; Cyber; Space). Initiate data analytics based on sensor output to assess operator cognitive status, and facilitate decision making. Initiate integrating sensing and intervention mechanisms to sustain and augment operator performance. Utilize these sensors and intervention inputs/outputs to optimize human-machine learning. ***FY 2025 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Biosciences Performance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue rapid Biological Recognition Element selection and optimization strategies. - Continue electrochemical and Field Effect Transistors-based biomarker sensing platforms, including synthetic biology developed components. - Continue optimizing synthetic biology capabilities to deliver biochemical interventions. - Continue the identification and optimize bio-molecular mechanisms to sense cognitive function, performance, fatigue, and stress in console operators (i.e. Intelligence, Surveillance, Reconnaissance; Cyber). - Continue data analytics based on sensor output to assess operator cognitive status, and facilitate decision making. - Continue integrating sensing and intervention mechanisms to sustain and augment operator performance. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.769 million. Funding decreased due to Air Force funding re-prioritization.			
Title: Biotechnology for Performance ***Description:*** Conduct research in systems biology, synthetic biology, and physiologic risk assessment research to focus on the underlying mechanisms contributing to individual performance in various operational environments through the integration of multiple genetic and biomarker technologies. Conduct research to utilize biomarker technologies to determine the risk associated with exposure to toxic compounds and materials. Resulting research will generate biomarker candidates for sensing personalized predictions of response to stressors and novel interventions to optimize, safeguard, and restore Airman performance. In FY 2023, this effort changed names from Systems Biology for Performance to Biotechnology for Performance. ***FY 2024 Plans:*** Complete a microfluidic "brain-on-a-chip" platform simulating the dynamic environment and physiologic conditions of brain cells/ tissue to include blood brain barrier oxygen dynamics. Continue utilizing advanced bio-data analytics and bioinformatics processing to analyze, and leverage these comprehensive baseline biomarker validation in a large-scale cohort developing Airman-specific predictive algorithms for physical/cognitive state, as well as personalized sustainment/augmentation strategies utilizing advanced bio-data analytics and bioinformatics processing. These relevant biomarkers will be used to generate optimal targets for sensor development for personalized state assessment enabling real-time feedback and performance optimization. Complete the identification of a nasal microbiome strain suitable for improved stress resilience. ***FY 2025 Plans:*** - Continue utilizing advanced bio-data analytics and bioinformatics processing to analyze biological mechanisms in Airmen, leveraging comprehensive baseline biomarker validation in a large-scale cohort to develop Airman-specific predictive algorithms for physical/cognitive state, as well as personalized sustainment/augmentation strategies utilizing advanced bio-data analytics and bioinformatics processing. These relevant biomarkers will be used to generate optimal targets for sensor development	7.611	6.444	5.675

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Biosciences Performance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
for personalized state assessment enabling real-time feedback and performance optimization, as well as inform human digital engineering efforts. - Initiate the advancement of microfluidic "organ-on-a-chip" platforms to interrogate the interactions between multi-organ systems, through simulation of the dynamic environment and physiologic conditions of tissues. - Initiate validation trials of an engineered probiotic designed to mitigate cognitive fatigue and enhance airman performance. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.769 million. Funding decreased due to Air Force funding re-prioritization.			
Title: Applied Cognitive Neurosciences ***Description:*** Develop technologies in cognitive neuroscience and physical performance to sustain, augment, and recover operator performance and determine performance attributes/metrics for optimal career field alignment. Includes research focused on developing and validating physiological and behavioral assessments of current and predicted cognitive state combined with personalized cognitive performance enhancement techniques and technologies to augment operator performance. In FY 2025, this effort changed names from Cognitive and Physiological Performance to Applied Cognitive Neurosciences. ***FY 2024 Plans:*** Continue evaluating brain machine interface technology applications that enhance human machine teaming performance. Continue maturing existing brain machine interfaces, neurotechnology, and advanced algorithms towards a candidate product capable of monitoring brain state, and applying non-invasive interventions that accelerate training and enhance skill retention. Initiate modeling for neural and physiological patterns associated with decision making, and evaluate neuromodulation approaches for inducing an optimal decision making state. Complete transition of neuromodulation technologies for mature devices and applications (e.g. accelerated training of image analysts) while simultaneously exploring and maturing neuromodulation technology (e.g. focused ultrasound and magnetic devices) paradigms for new cognitive enhancement/ sustainment applications. Continue real-time analytics testbed with additional capabilities and utilize for cognitive probing validation and replication experiments. ***FY 2025 Plans:*** - Continue evaluating brain machine interface technology applications that enhance human machine teaming performance. - Continue developing algorithms to assess the cognitive state of the Airman via passive brain-computer interface for real-time assessment of workload, attention, and uncertainty. - Continue constructing methods to communicate these states to Artificial Intelligence-enabled technology to provide superior human-machine teaming/interaction (outcomes of decisions made by human-machine teams are optimized when the machine understands the moment-to-moment cognitive of their human teammate).	7.611	16.109	14.521

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Biosciences Performance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue modeling neural and physiological patterns associated with superior decision-making and evaluate neuromodulation approaches for inducing an optimal decision-making state. - Initiate evaluating the effects of neuromodulation technologies on brain activity using advanced neuroimaging techniques. - Initiate neuromodulation paradigms with new technologies (e.g. peripheral nerve stimulation, focused ultrasound stimulation, and photo-biomodulation) for cognitive enhancement across Air Force career fields (i.e., piloting; intelligence, surveillance, and reconnaissance; cyber operations; special operations). ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $1.588 million. Funding decreased due to Air Force funding re-prioritization.			
Title: Performance Impact of Flight	7.611	3.221	3.216
Description: Conduct research investigating Airman performance degradation resulting from exposure to air environments, and seek understanding the fundamental mechanisms driving environmental and operational risks. Develop technologies to mitigate or eliminate the root physiologic causes of these degradations and to ultimately optimize Airman performance resulting in the capability to fly faster, higher, and longer than our adversaries. In FY 2025, this effort changed names from Performance Impact of Air and Space to Performance Impact of Flight. ***FY 2024 Plans:*** Continue applied research for Air Force customers in areas of aircrew injury assessment/mitigation and Onboard Oxygen Generation System operational performance assessment and enhancement. Continue research to characterize aircrew motion, biomechanical sensitivity to aircrew flight equipment and systems, the cause of acute and chronic back/neck pain, and musculoskeletal injuries towards the development of a Multi-Axial Neck Injury Criteria and Lumbar Injury Criteria. Complete mitigation strategies such as physical conditioning, system design improvements, and interventional strategies to repair post-sortie injury from high-G exposures. Continue human digital engineering algorithms and models for fighter and bomber aircraft system design, and human factors analysis applications. Initiate development of air supply pressure stabilization system to mitigate air supply pressure degradations. Initiate investigation into system integration approaches for fighter/trainer/bomber aircraft of onboard oxygen generation systems. ***FY 2025 Plans:*** - Continue research for Air Force customers in areas of aircrew injury assessment/mitigation and Onboard Oxygen Generation System operational performance assessment and enhancement to eliminate dependence on aircraft environmental control system.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Biosciences Performance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue research to characterize aircrew motion, biomechanical sensitivity to aircrew flight equipment and systems, the cause of acute and chronic back/neck pain, and musculoskeletal injuries towards the development of a Multi-Axial Neck Injury Criteria and Lumbar Injury Criteria. - Continue developing human digital engineering algorithms and models for fighter and bomber aircraft system design, and human factors analysis applications. - Initiate vetting tech solutions for clinical evaluation of musculoskeletal function and investigating of biomechanical injury mechanisms from aircraft environment. - Initiate digital transformation of data infrastructure for machine learning/Artificial Intelligence-Driven analytics, multi-modal sensing capabilities, and computational modeling. - Initiate development of Next Gen Medical Oxygen Concentrator using ion transport membrane technology to support aeromedical evacuation mission. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.005 million. Justification for this decrease described in plans above.			
Accomplishments/Planned Programs Subtotals	30.444	32.218	29.087

	FY 2023	FY 2024
Congressional Add: Critical Air Transport Technology Expansion ***FY 2023 Accomplishments:*** Congressionally directed effort (Critical Air Transport Technology Expansion) was moved to PE 0603456F / Human Effectiveness Advanced Technology Development, BPAC 635324 Biosciences Performance Demonstration for execution. ***FY 2024 Plans:*** Not Applicable	0.000	0.000
Congressional Add: Advanced Warfighter Physiology and Operational Readiness ***FY 2023 Accomplishments:*** Conduct Congressionally directed efforts ***FY 2024 Plans:*** Not Applicable	4.000	0.000
Congressional Add: Special Tactics Support Assessment ***FY 2023 Accomplishments:*** Conduct Congressionally directed efforts ***FY 2024 Plans:*** Not Applicable	4.000	0.000
Congressional Adds Subtotals	8.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Biosciences Performance*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 625329 / *Warfighter Interfaces and Teaming*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
625329: *Warfighter Interfaces and Teaming*	0.000	35.346	44.454	42.884	0.000	42.884	43.981	44.533	49.415	50.391	Continuing	Continuing

Note

This program, BA 2, PE 0602202F, project 625329, Human Machine Interactions, is a new start.
This program, BA 2, PE 0602202F, project 625329, Distributed Teaming and Communication, is a new start.

A. Mission Description and Budget Item Justification

This project conducts research to achieve decision superiority across our forces, through research on advanced human-machine interfaces, joint-cognitive systems decision-making, distributed and collaborative teaming and communication enhancements. Research provides advanced warfighter Command and Control interface technology, team collaboration tools, intelligent decision aids, and agile communications management. Research is conducted in two focus areas: human-machine interactions and distributed teaming and communication. Human-machine interactions focuses on achieving decision superiority by optimizing human engagement with increasingly complex, highly automated, and Artificial Intelligence-enabled machines. Distributed teaming and communication research technology and methods to enhance the formation, assessment, and performance of distributed teams of warfighters as well as human-machine teams.

In FY 2025 Project 625329 Warfighter Interfaces and Teaming changed from Sensory Evaluation and Decision Science.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Collaborative Interfaces and Teaming	8.439	12.003	4.286
Description: Research new Human-Machine Teaming technologies and concepts (e.g., information portrayal, control devices, decision aiding algorithms and adaptive agents) for effective human-machine interaction and teamwork. ***FY 2024 Plans:*** Initiate research effort on team resilience; build upon foundation of novel teaming metrics research to develop prototype team health scanner tool. Initiate research on transparency for distributed teams; build upon Joint All Domain Command and Control playbook research to develop prototype support tools for multi-domain teaming. Continue research on human autonomy collaboration tools to enhance resiliency. Complete research on human implications of machine learning and run-time assurance technologies. Complete research focused on development of software architectures and platforms to enable human-machine-teaming for pilot-vehicle interfaces in operationally relevant scenarios, Unmanned Aerial System teaming, base defense, and air battle management. Initiate the exploration of test methods for achieving bi-directional transparency in human-machine teaming. Complete research on trust development within mixed human-synthetic agent teams. Continue transfer of authority research to facilitate rapid acquisition of situation awareness for unexpected custody of assets. Continue research methodologies to conduct operator-centric field evaluations of fielded automation/autonomy systems. Experiment with interface technologies for control of			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Warfighter Interfaces and Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
unmanned assets from aerial platforms. Continue to refine guidelines for engendering trust and/or suspicion in human-human and human-machine teams. ***FY 2025 Plans:*** - Complete research effort on team resilience; build upon foundation of novel teaming metrics research to develop prototype team health scanner tool. -Continue research on transparency for distributed teams; build upon Joint All Domain Command and Control playbook research to develop prototype support tools for multi-domain teaming. - Continue research on human autonomy collaboration tools to enhance resiliency. - Continue the exploration of test methods for achieving bi-directional transparency in human-machine teaming. - Complete transfer of authority research to facilitate rapid acquisition of situation awareness for unexpected custody of assets. - Continue research methodologies to conduct operator-centric field evaluations of fielded automation/autonomy systems. Experiment with interface technologies for control of unmanned assets from aerial platforms. - Continue to refine guidelines for engendering trust and/or suspicion in human-human and human-machine teams. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased from FY 2024 by $7.717 million. Funding decrease due to a reduced emphasis in operator-centric field evaluations, team resilience scanner tools, and transfer of authority research for rapid acquisition of situation awareness.			
Title: Multisensory Perceptions and Communication	12.855	16.892	8.584
Description: Multisensory Perception and Communication focuses on identifying and exploiting the underlying sensory and cognitive mechanisms mediating human perception and communication in order to inform the development of multimodal interfaces and speech/language technologies. Research examines sensory processing, multisensory integration, and human communication processes in simple and complex environments to identify the barriers to effective information transmission and inform the development of technologies to overcome, or exploit, those barriers in order to enhance Airmen performance. ***FY 2024 Plans:*** Continue behavioral research on issues associated with disrupted and degraded communication channels. Initiate natural ad hoc team coordination in emergency response and Joint-All Domain scenarios. Initiate the collection of communication data from live and simulated events in these domains, and use data to develop new models of natural human communication processes. Continue operationally-relevant speech databases and dialogue processes. Build and integrate algorithms from these new models into novel communication interface prototypes for effective and efficient human-autonomy teaming. Initiate the development of new tools for integrating situation awareness displays with language based communication systems, and evaluate these capabilities in laboratory studies and operationally-relevant testbeds. Complete the evaluation of Augmented and Virtual reality capabilities for providing information through additional perceptual channels (visual, haptic/tactile along with speech			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Warfighter Interfaces and Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
communications) for distributed, collaborative tasks, supporting multi-capable airmen. Complete multimodal symbiologies and evaluate, with subject matter experts from flight community and Special Forces, in simulation and real-world environments with appropriate environmental/task complexity. Complete the collection of behavioral and neurophysiological data, use to refine real-time model of attention and processing capacity, integrate into testbeds to evaluate as driver for adaptive interfaces. Complete the evaluation of new technologies focused on perceptual and communication disruption in field tests. ***FY 2025 Plans:*** - Complete behavioral research on issues associated with disrupted and degraded communication channels. - Continue natural ad hoc team coordination in emergency response and Joint-All Domain scenarios. - Continue the collection of communication data from live and simulated events in these domains, and use data to develop new models of natural human communication processes. - Complete operationally-relevant speech databases and dialogue processes. - Continue the development of new tools for integrating situation awareness displays with language based communication systems, and evaluate these capabilities in laboratory studies and operationally-relevant testbeds. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $8.308 million. Funding decrease due to a reduced emphasis in disrupted and degraded communications, speech databases and dialogue processes, and perceptual and communication disruption tests.			
Title: Human Machine Interactions	0.000	0.000	11.250
Description: Research to identify principles of human interaction with highly complex systems, including advanced automation and increasingly intelligent Artificial Intelligence-enabled machines. The goal of this research is to achieve and sustain decision superiority across complex and uncertain mission environments. Research areas include identifying, characterizing, and overcoming key challenges to warfighter interactions with complex and intelligent systems, situationally adaptive interface design and usability, knowledge representation across sensory modalities, system observability and transparency, directability, joint-cognitive decision making, and maintaining properly calibrated trust across changing conditions. ***FY 2024 Plans:*** Not Applicable ***FY 2025 Plans:*** - Initiate research on human-centric interfaces and interaction strategies for improved Artificial Intelligence/automation transparency across different mission applications and Artificial Intelligence methods (including generative Artificial Intelligence approaches). - Initiate research into strategies that optimize closed-loop system adaptations to current operator functional state (i.e., workload) for maximally performing human-machine teams.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Warfighter Interfaces and Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate research on advanced visualization techniques to enable warfighters to rapidly extract meaning from complex, uncertain, multi-dimensional data sources. - Initiate research on continuous planning techniques, tradecraft, and interface tools that streamline and strengthen multi-player, AI-enabled plan development, and assessment. - Initiate identification of interface implications of cognitive warfare; tools for improved situation awareness of cognitive warfare threats, better decision-making, and intelligently deploying and directing cognitive warfare related effects. - Initiate research on next generation interfaces for tactically managing next-generation platforms with an emphasis on interface standardization across platforms/missions. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $11.250 million. Funding increase due to added emphasis in a new thrust area for human-centric interfaces and interaction strategies with Artificial Intelligence, system adaptations for operator state to maximize human-machine teams, and decision-making and cognitive warfare related effects.			
Title: Distributed Teaming and Communication	0.000	0.000	14.478
Description: Research that explores the rapid formation, real-time assessment, and dynamically optimized performance of distributed heterogeneous teams of warfighters as well as human-machine teams to enable rapid, agile and robust mission operations. Research areas include methods to enable the rapid formation of mission-effective heterogeneous teams, dynamic monitoring/assessment of team performance through optimal assemblage of novel and existing metrics, adaptive tactics for recovery from real or predicted team performance degradations, and novel distributed communication and collaboration tools, technologies and management methods that are responsive to variable network environments. ***FY 2024 Plans:*** Not Applicable ***FY 2025 Plans:*** - Initiate research and development of novel, nonintrusive metrics, and models to dynamically assess distributed team performance and behavior. - Initiate research into natural language processing methods to improve teamwork assessments and mitigations. - Initiate research on adaptive communication management interfaces that enable resilient multi-mixed teams in Joint All Domain Command and Control operations. - Initiate research on distributed teaming: characteristics, influences, challenges, and collaborative solutions to maximize team situation awareness and dynamic task management. - Initiate research on enhanced conversational Artificial Intelligence to optimize human-automation teaming and enable high-bandwidth interaction with intelligent agents similar to humans.			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Warfighter Interfaces and Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate research on how best to integrate multi-domain information for rapid warfighter assessment and action in Joint All Domain Command and Control. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 increased compared to FY 2024 by $14.478 million. Funding increase due to added emphasis in a new thrust area for the development of metrics and models to assess distributed team performance and behavior, adaptive communication management interfaces, and integration of multi-domain information for rapid warfighter assessment.			
Title: System Analytics ***Description:*** System Analytics studies the macro-cognition of the Airman using computational tools to accomplish mission objectives, encompassing interactions between operators, analytics, and environment. The goal of this research area is to describe, assess, and design for effective integration of analytics into mission systems. ***FY 2024 Plans:*** Continue the assessing design systems and methods to effectively blend data analytics with human cognition, with the goal of enhancing Airman and Guardian decision-making and improving joint cognitive systems performance in the face of massive volumes of complex and fast-changing information. Initiate assessing and enhancing the impact of analytics on thinking and reasoning in order to tailor capabilities to the context-specific cognitive requirements of our Warfighters. Initiate sensemaking studies, improve situational awareness, and mitigate data overload in order to enable Warfighters to rapidly extract meaning from complex, uncertain, and multi-dimensional data sources. Specific work is being vectored to directly support Joint All-Domain Command and Control, with attention to experiments, studies, guidelines, and publications in high-priority and related strategic investment areas. ***FY 2025 Plans:*** - Complete the assessing design systems and methods to effectively blend data analytics with human cognition, with the goal of enhancing Airman decision-making and improving joint cognitive systems performance in the face of massive volumes of complex and fast-changing information. - Continue assessing and enhancing the impact of analytics on thinking and reasoning in order to tailor capabilities to the context-specific cognitive requirements of our Warfighters. - Continue sensemaking studies, improve situational awareness, and mitigate data overload in order to enable Warfighters to rapidly extract meaning from complex, uncertain, and multi-dimensional data sources. Specific work is being vectored to directly support Joint All-Domain Command and Control, with attention to experiments, studies, guidelines, and publications in high-priority and related strategic investment areas. ***FY 2024 to FY 2025 Increase/Decrease Statement:***	14.052	15.559	4.286

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Warfighter Interfaces and Teaming*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
FY 2025 funding decreased compared to FY 2024 by $11.273 million. Funding decrease due to a reduced emphasis in methods for blending data analytics with human cognition for airman decision-making in a complex environment.			
Accomplishments/Planned Programs Subtotals	35.346	44.454	42.884

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force			Date: March 2024
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 627757 / *Bioeffects*	

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
627757: *Bioeffects*	0.000	40.811	47.664	46.130	0.000	46.130	29.380	30.050	33.281	33.946	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts applied research on the effects of human exposure to electromagnetic energy (direct current to radio frequency to optical, scalable directed energy weapons, and other novel weapons). This research addresses mechanisms of interactions through fundamental physical principles, biological responses, and physiological outcomes. Research is divided into two core focus areas: novel directed energy bioeffects and mechanisms and directed energy modeling, simulation, and analysis. This research enhances combat survivability and systems effectiveness through technologies that enable deployed forces to counter optical threats and exploit optical systems for offensive applications. In addition, basic biological investigations into the mechanisms associated with high peak power and high average power radio frequency exposure allow for the exploitation of directed energy systems for offensive capabilities while protecting the warfighter from adversarial use of radio frequency technologies. The novel directed energy bioeffects mechanisms research examines the physical, physiological, behavioral, and neural interactions of electromagnetic energy with tissues to understand dose-response effects as well as reveal the means to cause or prevent a specific effect. The directed energy modeling, simulation, and analysis research focuses on new software components that represent and optimize concepts of novel system employment from the Airman standpoint. These components are matured for future transition and application for engagement-to-mission level simulations in which directed energy weapons are employed.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Novel Directed Energy Bioeffects and Mechanisms	14.367	16.682	16.154
Description: Conducts laboratory experiments to provide fundamental knowledge of mechanisms of interaction of directed energy with molecules, cells, tissues, organs, and whole organisms in support of military directed energy systems. Conducts laboratory experiments to understand the mechanistic and behavioral effects of novel weapon incidents to the Airman and to understand the effects of protection strategies on Airman performance.			
FY 2024 Plans: Continue collection and transition of data from multiple parameterization, validation and verification experimental studies to candidate products that support high peak power microwave, high energy laser, and other emerging novel weapon concepts in order to assure valid assessments of real-world concerns and manage the risks associated with technological surprise. Continue studies to further the understanding of high energy effects on critical tissues including dynamic tissue characteristics under high power insult. Extend prior-year studies to include additional near-to-mid infrared parameters to fill data gaps required for materiel selection of laser systems. Continue developing methodologies to understand vulnerabilities and vision effects, including impact of protective systems on color vision. Continue examining mechanisms emerging from subcellular and cellular level response to electromagnetic energy. Continue research that underpins enhanced assessment of operational exposures to battlefield directed energy environments to include counter directed energy weapon technology. Expand research data sets and expertise to activities			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 627757 / *Bioeffects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
that further the development of directed energy policy and exposure standards to maximize interoperability and safe use of technology. ***FY 2025 Plans:*** - Continue collection and transition of data from multiple parameterization, validation and verification experimental studies to support modeling simulation and analysis of high peak power microwave, high energy laser, and other emerging novel weapon concepts. This work assures valid assessments of real-world concerns and manages the risks associated with technological surprise. - Continue studies to further the understanding of dynamic tissue characteristics and cellular and subcellular response mechanisms following electromagnetic energy exposure. - Continue prior-year studies on near-to-mid infrared parameters to fill data gaps required for materiel selection of laser systems. - Continue developing methodologies to understand vulnerabilities and vision effects, including impact of protective devices on color vision. Tasks will also provide representation of laser vision impacts in virtual and augmented reality platforms to familiarize the warfighter with those effects. - Continue research that underpins enhanced assessment of operational exposures to battlefield directed energy environments to include counter directed energy weapon technology. - Continue to expand research data sets that further the development of directed energy policy and exposure standards to maximize interoperability and safe use of technology. - Continue to accelerate biological and behavioral investigations of novel waveforms to mitigate technological surprise. Explore relevant mechanisms, dosimetry and diagnostic methodologies , and inform treatment options. Expand upon and validate damage from potential threat systems using advanced imaging technique and systems. - Complete supercontinuum parameterization in the near infrared region to address identified technical gaps and damage thresholds for safety standards. -Initiate assessment of non-linear optical damage from emerging laser threats. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $0.528 million. Funding decrease due to a reduced emphasis in funding keeping pace with high priority, real-world events.			
Title: Directed Energy Bioeffects Modeling, Simulation and Analysis ***Description:*** Conducts physics-level modeling and simulations to represent and optimize directed energy bioeffects to include direct, scalable, and collateral effects. ***FY 2024 Plans:***	26.444	30.982	29.976

Exhibit R-2A, RDT&E Project Justification: PB 2025 Air Force		Date: March 2024
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 627757 / *Bioeffects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Continue advancing dose-response models to include severity of injury as part of employment risk as a function of directed energy weapon parameters. Continue advancing three-dimensional digital anatomical models for use within physics-level software, and leverage these models against empirical datasets for advanced validation purposes. Continue maturing approaches for utilizing high performance computing to quantify the uncertainty within multi-physics bioeffect simulations of directed energy in end-to-end simulations at the engineering, engagement and mission levels, incorporating models from other collaborative organizations. Continue extending modeling approaches for surrogating physics-level simulations through machine learning approaches, and suitable for integration for digital representation of human throughout analyses. ***FY 2025 Plans:*** - Continue advancing dose-response models to address data parameter gaps and to incorporate severity of injury as part of employment risk as a function of directed energy weapon parameters. - Continue advancing three-dimensional digital anatomical models, increasing resolution, dynamic properties, and adapting for use within advancing physics-level. - Continue maturing approaches for utilizing high performance computing to quantify the uncertainty within multi-physics bioeffect simulations of directed energy in end-to-end simulations at the engineering, engagement, and mission levels, incorporating models from other collaborative organizations. - Continue extending modeling approaches for surrogating physics-level simulations through machine learning approaches, and suitable for integration for digital representation of human throughout analyses. - Continue virtual reality component development for vision effects (glare/dazzle) for transition into 6.3 program. - Initiate dose-response library updates based on most recent scientific data parameterizing responses form emerging systems and severity of injury. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 decreased compared to FY 2024 by $1.006 million. Funding decrease due to a reduced emphasis in funding keeping pace with high priority, real-world events.			
Accomplishments/Planned Programs Subtotals	40.811	47.664	46.130

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable