

DECADE OF VISION

an initiative of the
Alliance For Eye And Vision Research

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The Value of Defense-Related Vision Research: Peer-Reviewed Vision Trauma Research Program in Defense Appropriations

What is the Vision Trauma Research Program (VTRP)?

The dedicated VTRP budget line in Defense appropriations funds extramural vision research into immediate battlefield needs that is not conducted by the Department of Veterans Affairs (VA), elsewhere within the Department of Defense (DOD, including the Joint DOD/VA Vision Center of Excellence, VCE), the National Eye Institute (NEI) within the National Institutes of Health (NIH), or by private foundations. Although former Secretary of Defense Robert Gates identified Restoration of Sight and Eye-Care as one of four top priorities for deployment-related health research funding [with Traumatic Brain Injury (TBI), Post Traumatic Stress Disorder (PTSD), and Prosthetics], DOD has not yet established adequate “core” funding to address all vision research gaps, so VTRP funding is necessary.

The VTRP addresses deployment-related DOD-identified vision research gaps (see inside page). It was established in Fiscal Year (FY) 2009 appropriations. Although the vision community has consistently requested \$10 million in each funding cycle, annual appropriations have ranged from \$3.25 million to \$5 million. Vision, the sense most critical for optimal military performance in battlefield and support positions, is most vulnerable to acute and chronic injury. Research to effectively treat acute eye damage can have long term implications for an individual’s vision health, productivity and quality of life for the remainder of military service and into civilian life.

Traumatic eye injury from penetrating wounds and TBI-related visual disorders ranks second only to hearing loss as the most common injury among active military:

- Traumatic eye injuries have accounted for upwards of 16 percent of all injuries in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF)
- Male soldiers ages 20–24 account for 97 percent of visual injuries
- Eye-injured soldiers have only a 20 percent return-to-duty rate as compared to an 80 percent rate for other battle trauma injuries
- More than 58,000 enrolled OEF/OIF veterans have been diagnosed with eye conditions
- VA studies estimate that upwards of 75 percent of all TBI patients experience short- or long-term visual disorders, including double vision, sensitivity to light, inability to read print, and other cognitive impairments

How Much Have Military Eye Injuries and Blindness Cost the US?

In May 2012, Kevin Frick, Ph.D. (Johns Hopkins Bloomberg School of Public Health) released the results of a first-ever study of the costs associated with military eye injuries and blindness. The study, entitled *Costs of Military Eye Injury, Vision Impairment, and Related Blindness and Vision Dysfunction Associated with Traumatic Brain Injury without Eye Injury*, used only published data from 2000–2010 and widely accepted economic conventions to characterize the incidence numbers and concomitant costs associated with eye injuries, which range from superficial to one-eye or two-eye (bilateral) blindness, as well as visual dysfunction associated with TBI.

Based on the published data from 2000–2010, the total incident cost of eye injury each year has been \$2.282 billion, yielding a total cost to the economy over this timeframe of **\$25.107 billion**, which reflects:

- \$634 million in first-year costs, which have already been spent
- \$188 million present value of Department of Veterans Affairs (VA) benefits
- \$24.286 billion in present value costs to the economy and society (Social Security benefits, lost wages, family care)

In announcing the results, Dr. Frick reiterated that this was the first-ever estimate of these costs. As a result, he used only published data so that costs would not be overstated. He acknowledged limitations to the study, especially related to the growing knowledge about the diagnosis and treatment of visual dysfunction from TBI. “As we learn more in that regard, the estimated costs would likely be greater,” he stated.



Kevin Frick, Ph.D. (Johns Hopkins Bloomberg School of Public Health) presents study results in May 2012 at the annual meeting of the Association for Research in Vision and Ophthalmology (ARVO). The study was conducted under contract with NAEVR.

2006

For the first time, Congress adds “vision research” to the 20+ areas of research eligible for funding within the \$50 million line in Defense appropriations for the Peer Reviewed Medical Research Program (PRMRP) within the Congressionally Directed Medical Research Program (CDMRP). Vision researchers competed effectively, receiving a total of \$7.5 million in PRMRP awards, or 15 percent of the \$50 million total pool of funds.

2007

PRMRP is not funded.

2008

Congress again includes “vision research” in the \$50 million pool of PRMRP/CDMRP funding in Defense appropriations. Vision researchers receive \$5.9 million in PRMRP awards, or 12 percent of the \$50 million total pool of funds.

2009

For the first time, Congress passes a Defense appropriations bill with a dedicated Vision Trauma Research Program (VTRP) line, funded at \$4 million. Cong. James Moran (D-VA) served as the lead champion for the dedicated line, and continues to do so.

2010

Congress funds VTRP in Defense appropriations at \$3.75 million.

2011

Congress funds VTRP in Defense appropriations at \$4 million.

2012

Congress funds VTRP in Defense appropriations at \$3.2 million, due to an across-the-board 20 percent cut to Defense Health Programs.

2013

Fiscal Years 2006-2013

Does the VTRP Have Bipartisan Congressional Support?

Since the VTRP is a relatively new deployment-related budget line in defense appropriations, the vision and veterans communities have been engaged in educating Capitol Hill and seeking bipartisan champions. House defense appropriations bills have traditionally specified a VTRP line funding level, while Senate defense appropriations bills have included vision research with other areas of research within a pool of funds, meaning that final VTRP funding is a result of the conferencing of these two different bills.



Blinded veteran Specialist Travis Fugate (retired) with Cong. Moran who has stated that, “If we are going to send our armed forces in harm’s way, then we have an obligation to invest in the development of the best possible care and treatment.” (*Military Times*, October 10, 2011).

House Proposes VTRP at \$10 Million

The House Appropriations Committee reports out a Defense appropriations bill that funds VTRP at \$5 million. On July 18, 2012, during House floor debate on the bill, Cong Tim Walz (D-MN), the highest ranking enlisted veteran to serve in Congress, is joined by Cong. Rodney Frelinghuysen (R-NJ) in supporting a successfully passed amendment to increase VTRP funding by \$5 million to a total of \$10 million. Cong. Walz had previously served as the author of a “Dear Colleague” letter to fellow House members urging VTRP funding at \$10 million.

Excerpt from Cong. Walz’s Floor Statement: “The brave warriors that sustain these [eye injuries], whether they’re puncture injuries or whether they’re from concussive blast injuries, start to manifest themselves in loss of vision and eye injuries. Of all of the TBIs that happen in the war zone, 70 percent suffer some type of vision loss. The research to deal with this has long-term benefits.”

In his floor Statement, Cong. Frelinghuysen acknowledged a blinded Marine from his district, First Lieutenant Tim Fallon, who lost his vision in combat operations in Afghanistan. Left to right: In late 2011, Blinded Veterans Association’s Tom Zampieri, Ph.D. accompanied First Lt. Fallon in meeting with Cong. Frelinghuysen’s Senior Policy Advisor Steve Wilson.



VSOs/MSOs Support the VTRP

In February 2012, the 26th annual edition of the *Independent Budget*—an annual set of recommendations to Congress regarding defense and veterans affairs funding which is developed by AMVETS, Disabled American Veterans, Paralyzed Veterans of America, and the Veterans of Foreign Wars and supported by 59 other Veterans Service Organizations (VSOs) and Military Service Organizations (MSOs)—once again recommends that Congress fund the VTRP at \$10 million to address combat eye injuries. The *IB* has recommended adequate funding for defense vision research since the February 2008 edition issued regarding the FY2009 budget.



Concurrent with the *Independent Budget* release, the Blinded Veterans Association (BVA) sends a letter to Congressional defense appropriators also requesting FY2013 VTRP funding at \$10 million. BVA was joined by signatories Paralyzed Veterans of America, Military Order of the Purple Heart USA, Inc., Veterans of Foreign Wars, Jewish War Veterans of the USA, National Association of Uniformed Services, and AMVETS. The American Legion also submitted its own letter of support.

What Are the DOD-Identified Vision Research Gaps?

Ground soldiers especially face numerous assaults that potentially impair visual function, including:

- Eye injuries from chemical, biohazard, laser, and environmental exposure
- Corneal (front-of-eye) and retinal (back-of-eye) injuries that are the result of direct blast injuries and are often not evaluated until a soldier's vital signs are first assessed and which, if not stabilized, lead to vision loss
- Visual disorders as a result of Traumatic Brain Injury
- Potential long-term ocular injuries from a blast wave's pressure differential

Due to the full spectrum of eye injuries—from superficial to blinding—as well as the military's desire to prevent injuries and to rehabilitate soldiers with injuries, the DOD has identified at least nine vision research gaps:

1. Mitigation and treatment of traumatic injuries, war-related injuries, and diseases to ocular structures and the visual system
2. Mitigation and treatment of visual dysfunction associated with TBI
3. Ocular and visual systems diagnostic capabilities and assessment strategies
4. Eye protection and vision loss prevention strategies
5. Vision rehabilitation strategies and quality of life measures
6. Epidemiological studies of military eye trauma and TBI-related vision dysfunction
7. Vision restoration
8. Vision care education, training and simulation
9. War fighter vision readiness and enhancement

How Is the VTRP Managed and Awards Made to Vision Researchers?

The VTRP is managed by the DOD's Telemedicine and Advanced Technology Research Center (TATRC) within the U.S. Army Medical Research and Materiel Command (USAMRMC). TATRC, located at Fort Detrick, Maryland, added VTRP management to its existing Vision Research Portfolio (VRP), which had included other past Congressionally-directed program requests.

TATRC's VTRP Programmatic Committee, chaired by TATRC Director Colonel Karl Friedl, Ph.D. and Colonel Donald Gagliano, M.D., Director of the joint DOD/VA Vision Center of Excellence (VCE), consists of ophthalmic and optometric consultants to the Army, Navy and Air Force, as well as representatives from the National Eye Institute (NEI), the Food and Drug Administration (FDA), and stakeholders from the vision community. The Committee develops a Program Announcement that seeks research proposals from vision researchers worldwide, evaluates the applicability of proposals to the DOD-identified vision research gaps, and determines awards after matching programmatic need with scientific peer review, which is conducted externally by the American Institute for Biological Sciences (AIBS).

What is the Vision Center of Excellence's Role in relation to the VTRP and TATRC?



Joint DOD/VA Vision Center of Excellence Director Colonel Donald Gagliano, M.D. speaking to vision researchers at the 2012 ARVO Annual meeting

The National Defense Authorization Act of 2008 [P.L. 110-181] created the joint DOD/VA Vision Center of Excellence to address the prevention, diagnosis, mitigation, treatment, research, and rehabilitation of military eye injuries and diseases, including visual dysfunction related to TBI. Although the VCE promotes collaboration, facilitates integration, and serves as an advocate for vision across the DOD and VA healthcare systems, its primary responsibility is the creation of the Defense and Veterans Eye Injury Registry. The Vision Registry will track all eye injuries, from initial treatment on the battlefield through follow-up care at the VA over a veteran's lifetime.

The Vision Registry will be especially vital in identifying the number and types of eye injuries, especially eye conditions whose onset does not occur until well after a soldier's exposure to environmental conditions, blast injuries, or a blast wave.

The VCE does not have intramural or extramural research funding to address DOD vision gaps. However, VCE Director Colonel Donald Gagliano, M.D. serves as the co-chair of TATRC's VTRP Programmatic Committee and ensures appropriate VCE input.

TATRC at the ARVO Annual Meeting

Each year, TATRC representatives attend the annual meeting of the Association for Research in Vision and Ophthalmology (ARVO), the world's largest organization for eye and vision researchers. In addition to speaking at a formal session on defense vision funding opportunities, they also meet for more than 30 hours in one-on-one sessions with researchers to discuss the DOD gaps and research that may be responsive to those needs.



TATRC Vision Portfolio Manager Robert Read describes plans for the Vision Research Program's FY2011/2012 funding cycle awards



TATRC representatives speak to a full room of vision researchers



Left to right: TATRC's Robert Read, Marc Mitchell, and Francis McVeigh, O.D., meet one-on-one with ARVO President Peng Khaw, M.D., Ph.D. (Moorfields Eye Hospital, London, UK) at ARVO's 2012 meeting. International researchers are eligible for VTRP funding.

What Types of VTRP Awards Has TATRC Made to Vision Researchers?

FY2009–2010 Funding Cycle

In the FY2009–2010 VTRP funding cycle, TATRC announced twelve grants to vision researchers that totaled \$11 million. This total reflected FY2009 and 2010 Congressional VTRP appropriations of \$4 million and \$3.75 million, respectively, plus \$4.1 million transferred over from TATRC's "sister" agency, the Clinical and Rehabilitative Medical Research Program (CRMRP), minus administrative costs. In adding funds to TATRC's portfolio, the CRMRP recognized the high quality of vision research grants (which scored at the highest percentile in peer review) and their responsiveness to DOD research gaps. The twelve awardees reflect ophthalmic and optometric researchers from the US, Ireland, and Israel.



As joint DOD/VA VCE Director Colonel Donald Gagliano, M.D. has noted, "Vision researchers have certainly raised awareness among DOD agencies for both the quality and responsiveness of their grant submissions to the current needs of our military."

FY2011–2012 Funding Cycle

In the FY2011–2012 VTRP funding cycle, TATRC will award \$14 million in grants, reflecting Congressional allocations of \$4 million in FY2011 and \$3.2 million in FY2012, plus \$7 million transferred over from other DOD agencies due the quality and responsiveness of the vision grants. In this cycle, TATRC received more than 150 grant "pre-proposal" submissions in response to its Program Announcement, which specified two types of grants: Hypothesis Development Awards, funded up to \$250,000 each, and Investigator-initiated Awards, funded up to \$1 million each. TATRC plans to announce award recipients at the end of FY2012.

What is an example of VTRP-funded TBI-related Vision Dysfunction Research?

Stacey Choi, Ph.D. (New England College of Optometry) and Randy Kardon, M.D., Ph.D. (University of Iowa)



technically have 20/20 vision yet have visual disorders since the processing is perturbed. Studying the body's natural reflexes provides one way of determining the extent of the problem."

On February 22, 2011, AEVR hosted a Congressional briefing entitled *Vision Research Meeting Battlefield Needs: Diagnosing Vision Problems Resulting from TBI* featuring Randy Kardon, M.D., Ph.D. (University of Iowa) and Stacey Choi, Ph.D. (New England College of Optometry, NECO), who were among the twelve researchers who received a total of \$11 million in VTRP grants from TATRC in its FY2009/2010 funding cycle.

Dr. Kardon, who is also funded by the VA, NEI, and private funding organizations, has applied aspects of his larger research portfolio to the problem—better diagnosing TBI-related vision problems—through his study of the brain's natural reflexes to visual stimuli. These include the pupil's light reflex (contractions of the pupil based on amount of light sensed by the eye), natural eye tracking of visual targets, and the activation of eyelid muscles in response to light. One goal is to develop a portable, hand-held device—perhaps even through a smart phone application—to quickly and inexpensively analyze the pupil's reaction to light. "Since about 70 percent of the brain's nerve connections are engaged in visual processing, a soldier could

Dr. Choi acknowledged that the VTRP award is her first major grant, as well as the first DOD award for NECO. Her research involves in vivo retinal imaging to detect microscopic changes in the retina—the photosensitive tissue at the back of the eye—to diagnose TBI and facilitate earlier intervention to improve visual outcomes. Dr. Choi is using Adaptive Optics (AO) technology that was initially developed for the military use and was then applied to the space program. AO corrects for distortions in optical imaging systems and essentially "supercharges" it, so in combination with current retinal imaging systems such as Optical Coherence Tomography (OCT) and Scanning Laser Ophthalmoscope (SLO), it can detect changes down to the cellular level. Due to its sensitivity, AO retinal imaging may be

One goal is to develop a portable, hand-held device—perhaps even through a smart phone application—to quickly and inexpensively analyze the pupil's reaction to light. – Dr. Kardon

especially valuable as a diagnostic tool in cases of mild TBI or in situations where a blast was too weak to cause damage detectable by standard screening standards, yet visual symptoms exist. As with Dr. Kardon's research, Dr. Choi's ultimate aim is to develop a compact battlefield-ready instrument that can diagnose TBI in-theatre.

Alliance for Eye and Vision Research (AEVR) Executive Director James Jorkasky has cautioned that, "Congress should not get the impression that funds transferred over to the VTRP from other DOD agencies are always going to be available. Congress needs to adequately fund the VTRP line as a dedicated program focused on all battlefield eye and vision trauma."



What is an example of VTRP-funded Rehabilitative Research?

On March 22, 2012, AEVR hosted a Congressional briefing entitled *Deployment-Related Vision Trauma Research: A Vision Enhancement System for the Blind and Significantly Visually Impaired*. Featured speaker James Weiland, Ph.D., an Associate Professor of Ophthalmology and Biomedical Engineering at the Doheny Eye Institute of the University of Southern California, described his research which addresses two DOD-identified vision research gaps—inadequate vision rehabilitation strategies and inadequate vision restoration and vision surrogates. Dr. Weiland was one of twelve domestic and international researchers who received a total of \$11 million in VTRP grants from TATRC in its FY2009/2010 funding cycle.

Communicating these computer vision-interpreted images to the user is just as important as capturing them. – Dr. Weiland

The vision enhancement system uses modern mobile computing and wireless technology, coupled with novel computer vision and human computer interfacing strategies, to provide information to help those with visual impairment navigate, find objects of interest, and interact with people. The system was designed primarily to assist individuals with visual disorders and blindness as a result of TBI. Recent reports estimate upwards of 200,000 OEF and OIF veterans having experienced mild-to-severe vision impairment from TBI, and that upwards of 75 percent of all patients with TBI reporting short- to long-term visual dysfunction, such as light sensitivity, double vision, inability to read print, and low vision. This is often accompanied by other cognitive disorders, such as memory loss, which affects an individual's ability to use past visual cues to navigate.

The system consists of a wearable camera—similar to that in current smartphones—which feeds images (for example, an exit sign in a room) into a computing system that processes, interprets, and identifies it using software algorithms—again, similar to that in current GPS systems and smartphones. The system then provides tactile (e.g. vibration) and/or auditory feedback to

the user as guidance, whether to navigate a room (locate an exit sign), locate a specific object (a chair that may block an exit route), or react to another person's visual cues (facial expression).

Dr. Weiland discussed the various challenges presented by “computer vision,” especially relating to object recognition and targeting. Object recognition can be complicated by light and/or shading on an object, as well as its orientation, which can make an image match difficult. Another challenge is visual targeting, such as identifying the object of interest (for example, a street sign) amidst extensive visual “background clutter.” He also explained that, unlike the human brain which “self corrects” for any blurring that could occur when rapidly scanning an environment with your eye, computer vision must be programmed to avoid distortion of images.

Communicating these computer vision-interpreted images to the user is just as important as capturing them. Dr. Weiland explained that vision impaired individuals often use other sensory modalities to accommodate, so tactile or auditory feedback that directs the user must not interfere with their natural responses to the environment. Comparing this system to the traditional use of a white cane, he commented that, “You have to be close to an object with a cane to detect it. This system can detect obstacles as far as five meters away and enable an individual to navigate around them. This not only relates to street level obstacles, but to other objects, such as low-hanging branches.”

He concluded by describing other bioelectronics projects being developed at Doheny and other research centers, including an “artificial retina” (which has been approved for sale in Europe), a visual cortex prosthesis which would stimulate the portion of the brain responsible for vision, and electrical stimulation of the eyelid which can restore the blink reflex.



Featured speaker James Weiland, Ph.D.
(Doheny Eye Institute/University of Southern California)



How Does the US Collaborate with its Allies on Defense Vision Research?

Project Gemini, a joint initiative between Blinded Veterans Association in the US and Blind Veterans UK (formerly known as St. Dunstan's), enables veterans who have recently lost their sight with opportunities to interact with men and women who have led happy and prosperous lives despite their blindness and can serve as role models. In May 2012, in its second year, a group of blind US veterans travelled to England for a week to meet with blind United Kingdom veterans. During the week, the veterans discussed blind rehabilitation and readjustment training, adaptive technology for the blind, and vision research, as well as visited attractions throughout England, many of which provided special tours in which the participants touched objects being described, such as armor, jewels, and architectural details.

This year, the four American Army veterans who were blinded in OIF, including Steven Baskis, Dexter Durrante, Timothy Hornik, and Mark Shrand, interacted with UK veterans Billy Baxter (blinded in Bosnia), Darren Blanks, Bill Drinkwater, and Ken Facal. BVA Director of Government Relations Tom Zampieri, Ph.D., VCE Director Colonel Donald Gagliano, M.D., VCE Associate Director of Rehabilitation and Reintegration Bobbi Hillen, and AEVR Executive Director James Jorkasky also participated. Blind Veterans UK's Cadet Youth Challenge Project Officer Colin Williamson and Membership Manager Simon Brown served as hosts.

On May 21, the delegation visited Moorfields Eye Hospital in London, where it was hosted by 2012-2013 ARVO President Peng Khaw, M.D., Ph.D., who serves as the Director of Research and Development and Director at the National Institute of Health Research (NIHR) Biomedical Research Centre (BRC), based at Moorfields, and the University College of London (UCL) Institute of Ophthalmology. Moorfields' researchers informed the audience of more than 50 invited guests about groundbreaking research to save and restore sight.



Blind Veterans UK's Brighton facility, the base for Project Gemini, hosts veterans for respite care, convalescence, training, and social activities

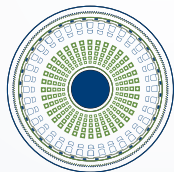


The entire group—US and UK blind soldiers, hosts, and guests—prepare for a tour of London and boat ride on the Thames prior to an afternoon of discussions at Moorfields Eye Hospital

Executive Director
James F. Jorkasky
240-221-2905 jamesj@eyerresearch.org

Director, Government Relations and Education
David H. Epstein
240-221-2902 depstein@eyerresearch.org

1801 Rockville Pike, Suite 400
Rockville, Maryland 20852-1606
www.eyerresearch.org



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Comments on Project Gemini

"It was a pleasure and an honour to meet these brave American and British veterans, most of whom have lost their sight while serving their countries. We were able to explain to them some of the state-of-the-art research being carried out here and at other NIHR research facilities elsewhere in the country. The work we discussed included some exciting and positive developments in regenerating damaged and diseased nerve cells and new stem cell transplantation and drug delivery discoveries which may in the future lead to people with loss of vision having it restored." –Dr. Khaw



Blind Veteran's UK Simon Brown (left) and Colin Williamson (right) greeted the US delegation, which included (left to right) AEVR's James Jorkasky, blind veterans Tim Hornik and Steve Baskis, BVA's Christina Hitchcock, blind veterans Mark Shrand and Dexter Durrante, and BVA's Tom Zampieri, Ph.D.



Left to right: BVA's Tom Zampieri, Ph.D., VCE Director Colonel Donald Gagliano, M.D., Lieutenant Colonel Andrew Jacks (Royal Centre for Defence Medicine, Queen Elizabeth Hospital, Birmingham), Air Vice Marshall Paul Evans (Commander Joint Medical Command and Surgeon General-Designate), and Dr. Khaw