

# ABM Newsletter

Spring 2006

## Special points of interest:

- Integrating the EEG System into combat helmets (see p. 4).
- Using EEG to optimize performance targeting Tomahawk Missiles (see p.4).
- Up to 23% of patients undergoing general anesthesia identified with severe risk of OSA with ARES (see Page 5).
- ABM announces new rental program for the ARES and EEG (see Page 6).

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## ABM's Key Milestones

- Momentum continues to build in the adoption of the Apnea Risk Evaluation System (ARES) and novel applications of the Electroencephalogram (EEG) headset and software with key customers and researchers.
- As we enter our second year of exhibiting at key trade shows, we expect our customer base to expand as awareness of our published outcome studies grows.
- The Company's research effort funded by the National Institute of Health (NIH) and Department of Defense (DoD) is helping to define new market opportunities and establish collaboration with thought leaders.
- R&D grants from NIH and DoD are funding the development of the next generations of the ARES and EEG products.



## ARES in the NFL: Complimenting wellness programs

**Dr. Archie Roberts**, former NFL player and founder of the **Living Heart Foundation (LHF)**, and his research collaborators **Dr. Charles George**, professor of medicine at the **University of Western Ontario**, **Dr. David Rapoport**, director of the **NYU Sleep Disorders Center**, and **Virend Somers** of the **Mayo Clinic**, continue to use the ARES to diagnose sleep apnea among former NFL football players. In the past year, ABM has assisted the LHF in studying over one-hundred ex-players in Miami, Philadelphia, Atlanta, Detroit and, most recently, Los Angeles.

At the **Super Bowl** screening in Detroit, **HBO Sports** was on the scene conducting interviews for an upcoming spotlight on the LHF screening program. With the preliminary data showing such an unusually high prevalence of OSA, the **NFL Player's Association** has committed to expanding the LHF screening program in NFL cities throughout the United States.

At each of the NFL screenings, local physicians are recruited to explain the symptoms, risks and treatment of OSA and cardiovascular disease to the players. **Dr. Roberts** reported that the players already have a heightened awareness of OSA and cardiovascular disease as a result of the recent deaths of Reggie White and Thomas Herrion. LHF will be using ARES exclusively at its upcoming screening starting in May in Buffalo.

## EEG Influencing Product Design: Machinery, Websites, Video Games

**“We’re looking for ways to help us better measure and quantify the user experience for the web sites we create and test. B-alert is a powerful tool, and we’re anxious to dive into the results of this first usability study.”**

**Caterpillar Inc.** has purchased our EEG system to complete neuroergonomic evaluations of new equipment designs. Our EEG systems will allow the company to evaluate the designs and quantify training efficiencies as a result of the improved designs. With our technology, the company plans to assess the operator’s comfort, level of engagement and cognitive workload when using their equipment. This practical application of our indices will bring *Caterpillar* objective evidence that the new designs require less cognitive effort on the part of the operator thus reducing the learning curve and saving customers time and resources required for training. **Resource Interactive**, a marketing company specializing in the plan, design and creation of websites, began a study at the end of April utilizing our B-Alert software. The study measured the engagement, mental workload and distraction as subjects interact with specified digital experiences and evaluate whether these measures can be used to determine optimal means for providing instructions and maintaining user interest. In application, our combined data could provide Resource Interactive enough information to identify the best means of reach-

ing target markets through electronic communication and marketing as well as enhance the services they provide to their clients. “We consider Advanced Brain Monitoring an important partner,” says Bob Hale, Usability Specialists at Resource Interactive. “We’re looking for ways to help us better measure and quantify the user experience for the web sites we create and test. B-Alert is a powerful tool, and we’re anxious to dive into the results of this first usability study.” **Arizona State University’s Center for Cognitive Ubiquitous Computing, Department of Computer Science and Engineering** reported their preliminary results on their study evaluating the user experience resulting from tactile stimulation during video games. This study asked that subjects play different genres of video games while wearing the EEG headset. During the games, subjects would receive a short or long vibration. The study determined that the use of the tactile stimulation improved the gamers’ experience. This data and the significant correlations may be used to design interfaces that make your gaming experience even more entertaining.

## EEG & Science Education: Improving Software, Improving Learning



Science education in the United States is said to be lagging behind several countries. Innovative teaching tools could be the solution.

With adequacy of the United States’ science education under debate, new products and technology are being developed regularly to attempt to prevent American students from falling behind.

With support and funding from the **Department of Education** and **National Science Foundation**, the **University of California Los Angeles**, in conjunction with the **University of Southern California**, have developed software, called IMMEX (Interactive

Multi Media Exercises) geared towards improving science knowledge and problem-solving skills in high school and college students. The innovative software is geared towards training and educating students, both individually and in groups, in science and scientific experiments. ABM will be helping make progress through the application of our B-Alert software and technology and the capture of real-time data. Data in real-time will

potentially allow programmers to immediately intervene and correct a problem such as a faulty decision, slow cognitive processing or interface difficulties as they arise. As training enhancement has become such a hot research topic, ABM looks forward to the study outcome and future work including studies with these educational institutions with a focus on identifying associations between cognitive states and the learning environment.

## EEG in Clinical Studies

Despite the widely publicized health risks of smoking, an estimated 25% of the U.S. population continues to smoke. Nicotine is a powerful stimulant that affects mood and cognition through the brain's dopamine system in a manner similar to that of other abused drugs such as cocaine. Nicotine is frequently used to counteract fatigue by people suffering from sleep deprivation as a result of lifestyle or undiagnosed sleep disorders. Although nicotine can temporarily sustain wakefulness and can improve performance in attention and memory tasks, abrupt withdrawal of the drug can cause deleterious effects on performance that can impact productivity and safety in military and industrial settings. Our study funded by the **National Institute on Drug Abuse** uses the AMP and EEG headset to evaluate the effects of nicotine administration and withdrawal on learning and memory performance including: monitoring EEG indices, the level of task engagement, distraction, drowsiness and mental workload.

We are nearing the completion of the Phase I study and our EEG measures of alertness and mental workload have proven highly sensitive to nicotine administration and withdrawal and predictive of performance in the vigilance and memory tests. We presented preliminary findings at two **DARPA** conferences, "Preventing Sleep Deprivation" and "Augmented Cognition" and at recent meetings on **Substance Abuse Program Administrators Association**. The results elicited a great deal of interest and enthusiasm for the sensitivity of our system in detecting the effects of nicotine and withdrawal and surprise at the magnitude of the stimulant effects and the deleterious effects of withdrawal.

ABM has also begun a joint collaboration with researchers at the **University of Arizona** and the **Mayo Clinic**, Scottsdale to use ABM's EEG technology to study a number of patient populations including patients with Parkinson's disease.

## Man and Machine: EEG Improving Interaction

**Design Interactive**, a company which evaluates Human Computer Interface (HCI) in training, simulation and other interactive software, and researchers at the **University of Central Florida**, have begun a **Defense Advanced Research Projects Agency (DARPA)** funded study that will attempt to identify brain indices of Situational Awareness including: perception, comprehension, and planning or projection. ABM's role is to identify the EEG patterns associated with situational awareness. Once the EEG indices are

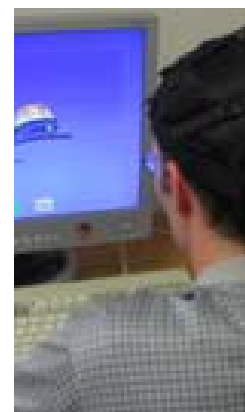
validated, ABM will be able to offer real-time data for identification of potential interface problems and facilitate their solutions. This would allow software, simulation and even video game programmers to quickly identify and correct human computer interface problems.

**Pacific Science & Engineering (PS&E)** enlisted the assistance of ABM's vigilance algorithms for an Army funded study using EEG to detect changes in human cognition during repetitive and tedious tasks. By identifying pre-

cursors to error and low vigilance, this study could assist in assuring accuracy in task completion through the use of signals to ensure vigilance in employees.

This assurance could easily be applied in monitoring, supervisory and other tasks in nuclear plants, transportation, shipping, defense, and manufacturing companies.

Design Interactive and PS & E findings will be presented at the Augmented Cognition (AugCog) conference in October.



With an increase in automation in the workplace environment, improved interaction can be a key to organizational success. Our technology could pinpoint problem areas in your software or hardware and provide solutions for your company.



**Construction workers, miners, power plant technicians, bikers, athletes or virtually any individual who wears a helmet or hardhat will be able to comfortably and safely wear the EEG headset.**

## EEG Improving Performance EEG in Mobile War Fighters and Tomahawk Missiles Operators

2006 marks the 4th year that ABM has been involved with **Defense Advanced Research Projects Agency Augmented Cognition (AugCog) Program**. This year is designated a key transition year for AugCog.

ABM is **Honeywell's** partner in transitioning AugCog to the U.S. Army. In January, ABM presented a design proposal as to how the EEG system could be integrated into the **Future Force Warrior Program** at the **Natick Soldier Systems Center**. Modifications of our EEG headset for use in military field training is underway and, by completing headset integration with the Kevlar helmets, our headset will be capable of gathering workload and other relevant data for **Honeywell** during military training exercises. EEG could also allow the Army to determine the drowsiness, mental workload, cognitive processing and other data of troops.

**Honeywell** will be fitting the EEG systems on soldiers at the **Aberdeen Proving Ground** in June to demonstrate the system's field readiness.

ABM is **Lockheed Martin Advanced Technology Laboratory's** partner in transitioning the AugCog program to the U.S. Navy. **Lockheed Martin** will utilize ABM's workload and engagement measures to determine the cognitive load and adjust the requirements of the user during a **Tactical Tomahawk Weapons Simulation**.

Concurrently, ABM has teamed up with **Lockheed Martin Integrated System and Solutions** group which will be using the B-Alert measures to assist in the design of new user interfaces for the **Tomahawk Weapons Program**. **Lockheed** has designed this study to enable one operator to complete work currently requiring four operators. The EEG indices will also be used to identify neuro-cognitive bottlenecks in the user interfaces. One outcome of this research study is to demonstrate to the U.S. Navy that **Lockheed** was able to significantly reduce the workload level of the operator with the new user interface.

Another key application of ABM's EEG technology was initiated with

**DARPA** funding to assess the impact of sleep deprivation, stress and fatigue on soldiers in the **United States Marine Corps**. ABM has teamed up with researchers from the **Space and Naval Warfare Systems Center** and the **Naval Health Research Center** to study soldiers during 30 days of continuous training at the **29 Palms Mohave Viper Training Program**. The training includes live-fire exercises and is designed to be the final stop before deployment overseas.

The study is designed to extract EEG measures that could predict future performance and decision making of troops and commanders who may be sleep deprived and in stressful situations. The study will include the modification of the EEG system to acquire heart rate information to assess stress levels. One of the intended outcomes of this research is to assist the **Marine Corps** in developing a fatigue management model.

**“Preliminary data found that close to 23% of the adult surgical population may be at high risk for OSA.” Dr. Finkel of Washington University**



## **ARES Reducing Risk of Surgical Complications**

A study designed by researchers at the **Washington University School of Medicine** and aimed at assessing the prevalence of undiagnosed obstructive sleep apnea (OSA) in patients preparing to undergo general anesthesia has reached its half-way point. Investigators at *Washington University* are administering our ARES Screener to patients as they visit the anesthesia clinic prior to surgery to identify patients with high risk for Sleep Apnea. Those identified are given an ARES Unicorder for one night. Currently, the ARES Screener has been used on over 2000 patients at **Barnes Jewish Christian Hospital** in St. Louis.

“Preliminary data found that close to 23% of the adult surgical population may be at high risk for OSA.” (Finkel, KJ, et al. Obstructive Sleep Apnea the Silent Pan-

dem). In the second phase, researchers will seek to determine whether sufferers of Sleep Apnea have a greater risk of complications post-surgery than those without Sleep Apnea. The ARES Screener and Unicorder will be used to predict which patients will have complications after surgery. If the findings are significant and reflective of the general surgical population, preoperative screening for Sleep Apnea could become standard.

More information on the *Washington University* study will be available online at [www.b-alert.com](http://www.b-alert.com).

Future studies regarding OSA and anesthesia are planned with the University of Louisville.

## **ARES Providing Dentists Tools to Demonstrate Treatment Efficacy**

ABM recently completed Phase I of a study funded by the **National Institute of Dental and Craniofacial Research** to evaluate the ARES as an assessment of the treatment outcomes of OSA using an oral appliance. The study collaborators included **Dr. Todd Morgan** who is affiliated with the **Scripps Hospital** in Encinitas, CA and **Dr. John Patrickus** in Green Bay, WI. The study showed 91% of the patients, many with severe OSA, were effectively treated with the oral appliance. Findings will be presented at the upcoming **Academy of Dental Sleep Medicine (ADSM)**, **Associated Profession Sleep Societies (APSS)** and the **8th World Congress on Sleep Apnea** conferences.

Most sleep medicine professionals recommend oral appliances for patients with mild to moderate OSA, in part, because of the uncertainty as to what factors influence a positive treatment outcome. Currently insurers typically reimburse for oral appliances only after patients fail to adjust to CPAP treatment. An important aspect of the completed study was to demonstrate that the

ARES signals are capable of “predicting” who will have a successful outcome with oral appliance therapy. A grant proposal was submitted at the end of March for Phase II funding to validate this measure and to compare changes in the Alertness and Memory Profiler as a result of CPAP vs. oral appliance therapy.

In response to the increased demand for dentists to provide objective measures of treatment success, ABM is preparing a unique marketing program allowing dentists to rent the Unicorders with ABM providing technical services as part of a per-patient fee. Initial response to the program was quite positive when presented at a seminar conducted by **Dr. Glenn Clark** at the **University of Southern California School of Dentistry**. ABM conducted ARES studies on two of the attendees and was provided an opportunity to demonstrate its automated scoring algorithms as part of the curriculum.

**“The study showed 91% of the patients, many with severe OSA, were effectively treated with the oral appliance.”**



## **ARES Taking Steps to Move into the Adolescent Market**

With funding provided by a new grant awarded from **NIH Child Health and Human Development Division**, a study will begin in June in collaboration with **Drs. Susan Redline** and **Carol Rosen** at **Case Western Reserve University**. Patients between the ages 13 to 18 will wear the ARES during their laboratory sleep study as well as in-home. These data will be used to obtain FDA clearance for the ARES in adolescents. The **Centers for Disease Control (CDC)** recently reported that the prevalence of obesity tripled in this group over the past twenty years and the prevalence of asthma doubled in the past decade. Because obesity and asthma are two important OSA risk factors for this age group, the size of this patient population is expected to increase substantially over the next few years.

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## **ABM Launches a Technology Rental Program**

Based on feedback and interest from corporate clients and researchers, a technology rental program has been launched for both the ARES and EEG systems. The ARES rental program is designed for clinicians who do not want to commit to the purchase of equipment, want assistance in editing nocturnal signals before generating diagnostic and treatment-outcome sleep study results, and/or need the study to be reviewed and interpreted by a physician board-certified in sleep medicine. The EEG rental program is designed for researchers who need multiple systems to study a number of subjects simultaneously or who have short term projects to investigate whether the EEG provides information that would be worth pursuing on a larger scale. In each of these cases, the rental program allows the customer the opportunity to trial the hardware and software with the option of converting to a purchase if they are satisfied with the program. The rental program will be prominently exhibited at the upcoming trade shows and on a number of trade-related web-sites.

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## **Recent Publications 2005-2006 Available at [www.b-alert.com](http://www.b-alert.com)**

- Evaluation of an EEG-Workload Model in an Aegis Simulation. Biomonitoring for Physiological and Cognitive Performance during Military Operations.
- Quantification of Alertness: Methods for Early Identification of Individuals Most Susceptible to Sleep Deprivation; Biomonitoring for Physiological and Cognitive Performance during Military Operations.
- Implementation of a Closed-Loop Real-Time EEG-Based Drowsiness Detection System: Effects of Feedback Alarms on Performance in a Driving Simulator.
- EEG Indices Distinguish Spatial and Verbal Working Memory Processing: Implications for Real-Time Monitoring in a Closed-Loop Tactical Tomahawk Weapons Simulation.
- Validation of an Apnea Risk Evaluation Questionnaire.
- Implementation Model for Identifying and Treating Obstructive Sleep Apnea in Commercial Drivers, Proceedings of the International Conference on Fatigue Management in Transportation Operations.
- Description and Validation of the Apnea Risk Evaluation System: A Novel Method to Diagnose Sleep Apnea-Hypopnea in the Home.
- Case Study on RDI Variability During Treatment with an Oral Appliance
- Evaluation of subjective measures of sleepiness in Obstructive Sleep Apnea patients pre- and post-treatment with CPAP and comparison to healthy controls
- Unattended monitoring for Sleep Disordered Breathing (SDB) using the ARES Unicorder
- Influence of Sleep-Disordered Breathing on Neurocognitive Functions Pre- and Post-Treatment with CPAP
- In-Home Evaluation of Efficacy and Titration of a Mandibular-Advancing Device for Obstructive Sleep Apnea

## Trade Shows and Presentations in 2006

Our website, [www.b-alert.com](http://www.b-alert.com), will have the latest updates on the trade shows and presentations as well as a list of contacts to request additional information before visiting our booth.

In March 2006, **Dr. Philip Westbrook** was a guest speaker at the OSTOP meeting to discuss the impact of OSA in the workplace. Attendees included key medical direc-

tors and human resource personnel from municipalities throughout southern California.

At an Employee Assistance Programs (EAP) Conference early this year, **Chris Berka** discussed the application of ARES and AMP and the topics of Sleep Deprivation and Preventative Measures Imperative to EAP. Look for the slide presentations to become available at [www.b-alert.com](http://www.b-alert.com) by mid-May.

ABM will be attending the American Occupational Health Conference (AOHC) for the second year this May. We will not be presenting, but we highly recommend that you

see the presentation on issues related to Commercial Driver Medical Certification.

June 5-7 at the **Surgery Sleep and Breathing**

### When & where to find us:

- **May 7-8th AOHC Conference in Las Angeles, CA. Visit Booth 101!**
- **June 15-17th ADSM Conference in Salt Lake City, Utah. Visit Booth 3!**
- **June 17-22nd APSS SLEEP 2006 in Salt Lake City, Utah. Visit Booth 112!**
- **October 15-20th AugCog HFES 50th in San Francisco, CA.**

Conference in Chicago, **Dr. Philip Westbrook**, our Chief Medical Officer, will be making a presentation entitled "Sleep Studies: What do we really need and how to get it."

In addition to having a booth at the **Academy of Dental Sleep Medicine (ADSM)** conference, **Dr. Todd Morgan** and **Dr. Philip Westbrook** will present data from our Oral Appliance study.

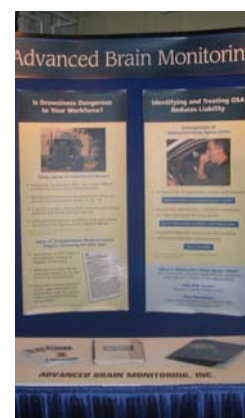
At the **APSS SLEEP 2006** Conference, **Dr. David Rapoport** and his colleagues from **NYU** will also be presenting data from the ARES independent validation study comparing the ARES to PSG.

**Chris Berka** will also be presenting study data which was gained through the AMP data acquisition software. She will be delivering her

findings on the association between hypoxemia in Sleep Apnea patients and memory deficiencies before and after CPAP treatment. Additionally, **Dan Levendowski** will present a case study on oral appliances

and repeated use of ARES.

**AugCog Human Factors and Ergonomics Society 50th** Conference will have ABM and our partners delivering some fascinating presentations as well. **UCLA** and **USC** will be presenting their preliminary data of their educational software study using our EEG and the AMP. Additionally, **PS&E** will be presenting the progress in their vigilance study which has been utilizing our algorithms, and **Honeywell**, **Lockheed Martin** and **Design Interactive** will be presenting their data gained while using our system.



**Please contact us if you would like copies of any of our scientific publications or presentations. Product brochures and recent press releases are also available on our website: [www.b-alert.com](http://www.b-alert.com)**



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Advanced Brain Monitoring, Inc. has developed patented technologies to address sleep apnea, memory dysfunction, and alertness monitoring. Our products combine laboratory level accuracy with the portability, ease-of-use, and affordability of consumer electronics.

The Apnea Risk Evaluation System (ARES) and EEG Technologies provide a synergistic approach to the assessment of sleep and neurological disorders, including diagnosis, measurement of treatment outcomes, and patient management.

Advanced Brain Monitoring's enabling technologies can be integrated into numerous products with multiple applications and markets. Advanced Brain Monitoring offers physicians, dentists, industrial/transportation companies, and consumers solutions to the problems of workplace fatigue, diagnosis of sleep and neurological disorders, and evaluation of pharmaceuticals

Founded in 1997, Advance Brain Monitoring is a privately held corporation based in Carlsbad, California. The company has received over \$8 million in grants from the National Institute of Health and the Department of Defense to develop and validate its innovative technologies. Our mission has been to develop truly innovative products based on what is demonstrably needed for patient care and public safety. We continually seek to improve our existing products, to fully and openly validate all products, and to subject all research to independent peer review.

### In Other News: Additions to the ABM team

Our company is growing! We have three new full-time employees and three interns.

Nancy Yan joined our team as a full-time employee on March 1st. Nancy will assist with technical customer service and special ARES projects.

Stacey Joseph, was hired as a full-time employee on March 17th. She is our latest addition to the ABM team. As a recent MBA graduate, she will be working within the sales and marketing department as well as the human resources department.

Sasha Tomic, a recent graduate from the University of Belgrade joins ABM as a software engineer.



**Our Carlsbad office is located at 2850 Pio Pico Drive, Suite A in Carlsbad, California 92008.**

Alan Yan, a Master's student in statistics at UCSD, is assisting us with our data analysis. Melissa Whitmore, also a student at UCSD, is assisting with data entry and analysis.

Karen Braich, who has been managing the EEG Nicotine study will be leaving to graduate school, next month.

ABM became a grandparent again, Zoran Matic recently witnessed the birth of his first son, Eliah.

We recently celebrated the first birthdays of Gene Davis's and Bata Velijkovic's daughters. Congratulations to all!