

Technical Inquiry 2016-0210

Neuromore LLC: Potential Department of Defense (DoD) Applications



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HDIAC Contract Number: FA8075-13-D-0001

Technical Inquiry Summary

HDIAC received a request from neuromore, LLC for an analysis regarding current Department of Defense (DoD) opportunities for a program that specializes in biodata acquisition for educational, training and restorative purposes.

Methodology

HDIAC reviewed and analyzed open source information on government and research center websites, including: U.S. Army Medical Department, Defense Advanced Research Projects Agency (DARPA), Telemedicine and Advanced Technology Research Center (TARC) and Congressionally Directed Medical Research Programs. All of the preceding agencies are involved in conducting neural research and developing technologies. To support this information, HDIAC utilized articles from the Journal of NeuroEngineering and Rehabilitation, the International Journal of Clinical and Experimental Hypnosis and the International Society for Neurofeedback and Research.

Background Information

Neuromore provides transformative experiences, using neurofeedback, which produce positive changes in psychological and physiological well-being.¹ Neurofeedback, or electroencephalogram (EEG) Biofeedback,² is the process of learning to control your brain activity based on operant conditioning principles.³ In 1938, Behaviorist B. F. Skinner developed the operant conditioning theory, which refers to changing behavior using a reinforcement.^{4,5} Neurofeedback is beneficial in treating PTSD, anxiety, chronic pain⁶ and poor performance—many symptoms faced by active and retired military service members.⁷

Application and Utilization within the Military

There is an increase in the incidence of Traumatic Brain Injury among active duty U.S. military personnel due injuries caused by heavy militant use of improvised explosive devices.⁸ Political instability and global conflict increase military operations and the need for military servicemen. Missions are longer, with multiple tours leading to less personal and recovery time.⁹ This demand effects service members' health and mental wellbeing. Many agencies look for ways to reduce mental strain and to treat service members suffering from memory loss, post-traumatic stress disorder (PTSD), anxiety, pain and poor performance. Neurofeedback training requires brain waves to be recorded and then uses operant conditioning where a person can learn to modify their brain waves to change their mental state.¹⁰ This change in mental state can help train and help recuperate military service members suffering from neurological ailments¹¹.

DARPA is working to restore active memory using an implantable neural-interface medical device. This will allow the agency to “deliver targeted neural stimulations that may ultimately restore memory function.”¹² DARPA is years away in developing neuroprosthetic hardware. The immediate goal is to develop prototypes for testing and to research the complex memory models in the brain. The biofeedback system provided by neuromore may provide insight to DARPA's neuroprosthetic device research. The real-time feedback in EEG can offer DARPA insight into the neural impulses it is trying to amplify and interpret.

Congressionally Directed Medical Research Programs such as the Autism Research Program (ARP) have partnered up with collaborators from the University of California at San Diego and are looking at the link between neurofeedback training and autism. Research shows children with autism who used neurofeedback therapy to reduce delta and theta brain waves show, “improved

cognitive flexibility [and]enhanced social and communicative skills.”¹³ Researchers at ARP want to make neurofeedback training easier to use and available for school or home use.¹⁴ Neuromore is uniquely positioned to offer neurofeedback in a variety of platforms including desktops or mobile applications. Neuromore could improve efficiency and speed at which therapy is offered and benefit individuals living with autism.

The U.S. Army Medical Department Medical Research and Materiel Command is interested in research regarding neurofeedback use to treat PTSD.¹⁵ This type of technology could allow servicemen to take PTSD treatment into their own hands and at their own pace.¹⁶ Neuromore can offer military servicemen the option to control their recovery by regulating and calibrating the neuromore program to suit their needs.

Telemedicine and Advanced Technology Research Center (TARC) works collaboratively with industry and academia to address requirements for medical research programs through special funding and partnership opportunities.¹⁷ Neuromore has the capability and functionality to provide unique products to TARC. The Mobile Health Innovation Center (mHIC) within TARC evaluates mobile health technologies that can support service members. Neuromore can provide a positive change to physiological and psychological well-being and may help mentally prepare servicemen for the difficult mission before deployment. A major factor for design and development for mHIC is the availability of programs across mobile platforms and ease of use for patient.¹⁸ Neuromore could meet these requirements to provide an all-inclusive elegant solution for a transformative experience.

Biofeedback training could be provided during simulation training for military service members before deployment. This unique training opportunity could help prepare service members for particular skills that will be necessary during high stress situations or when a quick recovery is necessary.¹⁹ Neurofeedback has proven to lower anxiety²⁰ and can help prepare service members for the upcoming mission.

Conclusion

As technology advances, neurofeedback training, equal to that offered by neuromore, will continue to prove multifunctional. PTSD, anxiety, chronic pain and performance are all manageable through neurofeedback training. The DoD and the civilian population would be interested in the utilization of these emerging technologies to treat and cure these devastating afflictions.

¹ Neuromore Home. (2015). Retrieved from <http://www.neuromore.com/#welcome>

² What is Neurofeedback? (2015). Retrieved from <https://www.eeginfo.com/what-is-neurofeedback.jsp>

³ Boxtel, G., & Gruzelier, J. (2014). Neurofeedback: Introduction to the special issue. *Biological Psychology*, 95, 1-3. doi:10.1016/j.biopsycho.2013.11.011.

⁴ McLeod, S. A. (2015). Skinner - Operant Conditioning. Retrieved from www.simplypsychology.org/operant-conditioning.html

⁵ Ciccarelli, S., & White, J. (2015). Learning. In *Psychology* (4th ed., pp. 187). Upper Saddle River, NJ: Pearson Education.

⁶ Jensen, M., Gianas, A., George, H., Sherlin, L., Kraft, G., & Ehde, D. (2015). Use of Neurofeedback to Enhance Response to Hypnotic Analgesia in Individuals With Multiple Sclerosis. *International Journal of Clinical and Experimental Hypnosis*, 64(1), 1-23. doi:10.1080/00207144.2015.1099400

⁷ Kallen, V., Wouwe, N., Delahaij, R., Boeschoten, M., & Vermetten, E. (2011). Using Neurological Feedback to Enhance Resilience and Reception. Retrieved from

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjiwipDt8c7JAhVKRYKHeYvAq8QFggdMAA&url=http%3A%2F%2Fwww.dtic.mil%2Fcgibin%2FGetTRDoc%3FAD%3DADA582852&usq=AFQjCNGE5n6_VrYhi4DZsy1ATZp_14C5XQ

- ⁸ Neumann, C., & Chukwuma, U. (2015). Early-onset Infectious Complications among Penetrating and Severe Closed Traumatic Brain Injury in Active Duty Deployed during OIF and OEF, 2008-2013. *Navy and Marine Corps Public Health Center Portsmouth VA Epidata Center Dept.*
- ⁹ Kallen, V., Wouwe, N., Delahaij, R., Boeschoten, M., & Vermetten, E. (2011). Using Neurological Feedback to Enhance Resilience and Reception. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjwipDt8c7JAhVKRyYKHeYvAg8QFggdMAA&url=http%3A%2F%2Fwww.dtic.mil%2Fcgibin%2FGetTRDoc%3FAD%3DADA582852&usq=AFQjCNGE5n6_VrYhi4DZsy1ATZp_14C5XQ
- ¹⁰ Kallen, V., Wouwe, N., Delahaij, R., Boeschoten, M., & Vermetten, E. (2011). Using Neurological Feedback to Enhance Resilience and Reception. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjwipDt8c7JAhVKRyYKHeYvAg8QFggdMAA&url=http%3A%2F%2Fwww.dtic.mil%2Fcgibin%2FGetTRDoc%3FAD%3DADA582852&usq=AFQjCNGE5n6_VrYhi4DZsy1ATZp_14C5XQ
- ¹¹ Kober, S., Schweiger, D., Witte, M., Reichert, J., Grieshofer, P., Neuper, C., & Wood, G. (2015). Specific effects of EEG based neurofeedback training on memory functions in post-stroke victims. *Journal of NeuroEngineering and Rehabilitation*, 12(107). doi:10.1186/s12984-015-0105-6
- ¹² Sanchez, J. (2015). Restoring Active Memory (RAM). Retrieved from <http://www.darpa.mil/program/restoring-active-memory>
- ¹³ Pineda, J. (2013, April 2). Improving Synchronization and Functional Connectivity in Autism Spectrum Disorder through Plasticity-Induced Rehabilitation Training. Retrieved from http://cdmrp.army.mil/arp/research_highlights/13pineda_highlight.shtml
- ¹⁴ Pineda, J. (2013, April 2). Improving Synchronization and Functional Connectivity in Autism Spectrum Disorder through Plasticity-Induced Rehabilitation Training. Retrieved from http://cdmrp.army.mil/arp/research_highlights/13pineda_highlight.shtml
- ¹⁵ Ruppert, B. (2012, November 26). Controlling post-traumatic stress could be as close as a game on a cell phone. Retrieved from http://mrmc.amedd.army.mil/index.cfm?pageid=media_resources.articles.cell_phone_game_helps_control_PTS
- ¹⁶ Ruppert, B. (2012, November 26). Controlling post-traumatic stress could be as close as a game on a cell phone. Retrieved from http://mrmc.amedd.army.mil/index.cfm?pageid=media_resources.articles.cell_phone_game_helps_control_PTS
- ¹⁷ Telemedicine & Advanced Technology Research Center (TATRC). (2015). About TATRC / Telemedicine & Advanced Technology Research Center (TATRC). Retrieved from <http://www.tatrc.org/www/about/>
- ¹⁸ Telemedicine & Advanced Technology Research Center (TATRC). (2015). Mobile Health Innovation Center (mHIC), Fort Gordon, Georgia / Telemedicine & Advanced Technology Research Center (TATRC). Retrieved from <http://www.tatrc.org/www/labs-and-programs/mobile-health/>
- ¹⁹ Kallen, V., Wouwe, N., Delahaij, R., Boeschoten, M., & Vermetten, E. (2011). Using Neurological Feedback to Enhance Resilience and Reception. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjwipDt8c7JAhVKRyYKHeYvAg8QFggdMAA&url=http%3A%2F%2Fwww.dtic.mil%2Fcgibin%2FGetTRDoc%3FAD%3DADA582852&usq=AFQjCNGE5n6_VrYhi4DZsy1ATZp_14C5XQ
- ²⁰ Dreis, S., Gouger, A., Perez, E., Russo, G., Fitzsimmons, M., & Jones, M. (2015). Using Neurofeedback to Lower Anxiety Symptoms Using Individualized qEEG Protocols: A Pilot Study. *The Journal of NeuroRegulation*, 2(3), 137-148. doi:10.15540/nr.2.3.137