



Approaches to Neuro-Hope: Assessment of Current and Near-Future Neuroscientific and Technological Trends, Capabilities, and Operational Uses

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ASSOCIATION FOR ENVIRONMENTAL HEALTH & SCIENCES FOUNDATION, INC.

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Final Report

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14. ABSTRACT This project assessed the capabilities, limitations, de-limitations and technical, social and ethico-legal implications of various forms of neuroscientific and technological assessments and interventions to affect neurological processes so as to modify, sustain and/or optimize human neurological health, operational protection and enablement, with particular emphases upon those ways that such approaches could be applied to United States Air Force personnel. The project engaged a variety of fora (i.e.- peer-reviewed publications, lectures/presentations, seminars and symposia) to pulse and contribute to the field by conjoining subject matter experts to the discourse and detailed examination. As per the Attachment (1), Deliverables of the project include: fourteen (14) publications in the international peer-reviewed or refereed literature; one (1) book chapter published in an international volume; twenty-seven (27) presentations/lectures given addressing the topic(s) in focus; two (2) international seminars; and a synoptic (mutually teleconferenced and in-house) symposium, held jointly at City College-CUNY and Georgetown University Medical Center.					
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FINAL REPORT

AIR FORCE GRANT #FA9550-17-1-0003

PI: James Giordano, PhD

***“ ASSESSMENT OF CURRENT AND NEAR-FUTURE NEUROSCIENTIFIC AND
TECHNOLOGICAL DEVELOPMENTS: PRACTICAL CAPABILITIES AND
NEUROETHICAL CONSIDERATIONS ”***

November, 2018

Final Report:
AEHS Foundation Sub-Award

Grant FA9550-17-1-0003, "Assessment of Current and Near-Future Neuroscientific and Technological Developments: Practical Capabilities and Neuroethical Considerations"

PI: James Giordano, PhD

Abstract:

This project assessed the capabilities, limitations, de-limitations and technical, social and ethico-legal implications of various forms of neuroscientific and technological assessments and interventions to affect neurological processes so as to modify, sustain and/or optimize human neurological health, operational protection and enablement, with particular emphases upon those ways that such approaches could be applied to United States Air Force personnel.

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Efforts and products of this project have generated increased awareness of, and continuing interest in the use of neuroscientific and neurotechnological methods and tools to assess and affect aspects of human cognitive and behavioral performance. As well, these efforts have engendered enhanced consideration of those ways that such approaches might be misused, and the ethical, legal and social issues generated by the use and misuse of these techniques and technologies in global settings.

The efforts of this project have been instrumental to developing ongoing activities and follow-up projects toward broader and deeper (theoretical, technical, empirical, and ethico-legal) exploration of the current, probable, possible and potential applications of neuroscientific and technological methods that may be viable for human performance optimization.

Attachment (1): Completed efforts/Deliverables

Papers published in international peer-reviewed/refereed journals (14):

Calabrese V, Santoro A, Trovato Salinaro A, **Giordano J**, Calabrese E. Hormetic approaches to the treatment of Parkinson's disease: Perspectives and possibilities. *J Neuro Res*. 96 (3) 1-22 (2018)

Snow JJ, **Giordano J**. Public safety and national security implications of the horsepox study. *Health Security* 16(2): 1-3 (2018).

Calabrese E, Iavicoli I, Calabrese V, Cory-Slechta C, **Giordano J**. Elemental mercury neurotoxicity and clinical recovery of function: A review of findings, and implications for occupational health. *Environ Res* 163: 134-148 (2018).

Wu S, FitzGerald KT, **Giordano J**. On the viability and potential value of stem cells for repair and treatment of central neurotrauma: Overview and speculations. *Front Neurol* 9: 1-24 (2018).

DiEuliis D, Lutes CD, Giordano J. Biodata risks and synthetic biology: A critical juncture. *J Bioterrorism Biodef* 9(1): 2-14 (2018).

Calabrese V, Santoro A, Monti D, Crupi R, DiPaola R, Latteri S, Cuzzocrea S, Zappia, **Giordano J**, Calabrese E. Aging and Parkinson's Disease: Inflammaging, neuroinflammation and biological remodeling as key factors in pathogenesis. *Free Rad Biol Med* 115: 80-91 (2018).

Giordano J. Weaponizing the brain: Neuroscience advancements spark debate. *Nat Def*, 6: 17-19 (2017).

Gerstein D, **Giordano J**. Re-thinking the Biological and Toxin Weapons Convention? *Health Security* 15(6): 1-4 (2017).

Shook JR, **Giordano J**. Moral bioenhancement for social welfare: Are civic institutions ready? *Front Sociol* 2(21): 1-5 (2017)

DiEuliis D, **Giordano J**. Gene editing using CRISPR/Cas9: implications for dual-use and biosecurity. *Protein and Cell* 15: 1-2 (2017).

Calabrese EJ, Calabrese V, **Giordano J**. Role of hormesis in functional performance and protection of neural systems. *Brain Circ*, 3(1): 1-13 (2017).

Raynor S, **Giordano J**. Treating Alzheimer's dementia with CT-induced low dose ionizing radiation: Problematic, yet potential for more precise inquiry. *Dose Response* 12: 1-4 (2017).

Giordano J, Bikson M, Kappenman ES, et al. Mechanisms and effects of transcranial direct current stimulation. *Dose-Response* 1-22 (2017).

Calabrese V, **Giordano J**, Crupi R, et al. Hormesis, cellular stress response and neuroinflammation in schizophrenia: Early onset versus late on set state. *J Neurosci Res* 95(1): 2-24 (2017).

Book chapters (1)

Tennison M, **Giordano J**, Moreno J. Security threat versus aggregated truths: Ethical issues in the use of neuroscience and neurotechnology for national security. In: Illes J, Hossein S (eds.) *Neuroethics: Anticipating the Future*. Oxford: Oxford University Press (2017), pp. 531-553.

Lectures and presentations, J. Giordano (27):

19 June 2018. Emerging neurotechnology; essential neuroethics. Invited plenary: National Institute for Standards and Testing, Rockville, MD

2. June 2018. Engaging neurotechnologies for cognitive and behavioral optimization. Invited lecture and panel presentation: Science and Technology Policy Institute, Washington, DC.

17. May 2018. Updates on neuroethical, legal and social issues in this year of DBS research and clinical therapeutics. Plenary: Sixth Annual Deep Brain Stimulation Think Tank, Atlanta, GA.

6. April 2018. Neuroscience and technology and the need for neuroethics. Plenary: Brain Health and Performance Summit, Ohio State University, OH.

3. April 2018. Weaponizable brain science: An international perspective and need for engagement. Invited lecture: Strategic Multilayer Assessment Annual Conference, Joint Base Andrews, MD.

3. April 2018. Neuroethico-legal and social implications of the N3 Program. Invited lecture: Defense Advanced Research Projects Agency N3 Project Proposers' Day, Arlington, VA.

30 March 2018. Neuroplasticity, performance optimization and neuroethico-legal considerations. Invited lecture: Arizona State University DC Campus Center Workshop on Neuroplasticity and Performance, Washington, DC.

20 March 2018. Building better brains: Neurotechnology and the need for informed neuroethics. Invited Annual O'Malley Lecture, Loyola Marymount University, CA.

13. March, 2018. Non-invasive brain stimulation to optimize cognitive and motor performance: Neuroethical issues and address. Invited plenary: US Air Force Office of Scientific Research Conference on Non-Invasive Neuromodulation and Performance Enhancement; Arlington, VA.

10. March, 2018. PANS and PANDAS as neuro-inflammatory spectrum disorders: Implications for ethical assessment and care. Invited plenary and session chair: Common Threads Conference 2018; Columbia University, NY.

9. March 2018. Predictive and prescriptive neurology: Emerging neurotechnology and the need for neuroethics. Invited grand rounds: Medical College of Wisconsin; Milwaukee, WI

14. December, 2017. Kühne neue Neurowissenschaft: Warum brauchen wir eine Neuroethik? Invited lecture: Philosophisches Cafe, Coburg, GER

1. December 2017. Picturing passing: Neuroimaging and neuroethical issues in brain death. Invited plenary: Brain Death: New Questions for Philosophy and Theology. Kennedy Institute of Ethics, Washington, DC.

21. November 2017. Neuroweapons: Viability in military and intelligence operations and neuroethico-legal considerations and concerns. Invited briefing: US Army Special Operations Command, Washington, DC

2. November 2017. Neurotechnology futures: Research, uses and the need for neuroethics. Invited lecture: IEEE Biomedical Section Meeting, Arlington VA

26. October 2017. Neuroethical issues in research and treatment of Parkinson's disease. Plenary: Parkinson's Foundation Gala, Washington, DC

6. October 2017. Neuroweapons: Addressing the ethical issues of development and employment. Invited keynote: Deutsche Bundeswehr Annual Technology Conference, Washington, DC

14. September 2017. Ethical issues in the international development and use of neurotechnology. Session chair and plenary: OECD Conference, Washington, DC.

5. August, 2017. Neuroethics: Addressing the good, bad and ugly applications of neuroscience in psychology. Keynote: American Psychological Association Conference, Washington, DC.

26. July 2017. Neuroscience and technology in national security and defense: Technical capabilities, neuroethical considerations. Invited plenary: US Army Training and Doctrine Command "Mad Scientists" Conference, Washington, DC.

26. July 2017. Neuroscience and technology in national security and defense: Technical capabilities, neuroethical considerations. Invited plenary: US Army Training and Doctrine Command "Mad Scientists" Conference, Washington, DC.

27. June 2017. Neuroscience in irregular warfare. Invited plenary: Center for Irregular Warfare and Groups, US Naval War College, Newport, RI.

13. June 2017. Brain science from bench to battlefield: The realities – and risks- of neuroweapons. Invited plenary: Center for Global Security Studies, Lawrence Livermore National Laboratory, Livermore, CA.

30. June, 2017. Neuroethical issues in the use of emerging neuroscience and technology in the assessment and treatment of Parkinson's disease. Invited plenary: Parkinson's Foundation Annual Conference, NY, NY.

12. May, 2017. Brave new brain science: Practical and neuroethical considerations of neuro-cognitive performance optimization. Plenary teleconference: Universidad de Anahuac, Anahuac MX.

25. April, 2017. Neuroscience and neurotechnology as leverage for strategically latent influence upon the 21st century global stage. Plenary: SMA Strategic Influence Conference, Joint Base Andrews, MD.

20. April, 2017. Cutting edged neuroscience: Carefully considered Neuroethics. Invited lecture: Department of Neuroscience, Harvard University, Cambridge, MA.

Other activities:

Symposium: Non-invasive brain stimulation: Optimizing human performance - Technical and ethical issues. 13. June, 2018, City College NY, NY-Georgetown University Medical Center, Washington DC

Seminar "*Pre-adaptive processes in neural systems: Mechanisms and practical considerations*". E. Calabrese, J. Giordano. 7. November, 2017, Georgetown University Medical Center.

Seminar: *"Neural health, optimization, protection and enhancement: A model for health promotions?"* RegioMed Medical Center, Coburg Germany, 13. December, 2017.