

Title: Interogenesis-Interoception: Astronaut Inner Space tactic for Autonomous Healthcare, ISS Collaboration for Covid-19 Vaccine R&D.

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Across history, pioneers relied upon will power, an inner compass/knowing, and ingenuity to face the uncertainties, problems, and mysteries of the frontier. A pioneer's 'inner space' influences their exploration of outer space. 'Inner space', a metaphor to describe the deep, internal psychophysiology of Interogenesis & Interoception (I&I), is a less developed frontier of astronaut autonomous healthcare, and self-care, for space missions. The I&I Inner Space offers broad application on earth, immediate support for Covid-19 vaccine R&D, and, and promotes the development of ISS commercial activities.

Interogenesis & Interoception (I&I) fill a critical gap in autonomous healthcare and contribute new countermeasures for The Human Research Roadmap (HRR) and CBS Integrated Research Plan (CBS - Central Nervous System, Behavioral Medicine, Sensory Motor) countermeasures. The I&I model addresses an undervalued therapeutic countermeasure to a significant portion of total healthcare costs on earth. I&I has immediate application to research and development for a COvid-19 vaccine, due to I&I's application to immune system regulation.

Interogenesis & Interoception are innate, biological abilities of all people; what we feel inside our inner space, and what we activate inside our inner space. For space health, Interoception is the astronaut's ability to develop, train, and ascribe meaning to subjective, internal, personal, self-diagnostic biomarkers of their health status at deep layers of psychophysiology. Interogenesis, is the process of using the knowledge gained from Interoception to apply self-directed, volitional, internal therapeutic action (force/work signals) to support multiple health risks, relevant operational pathways, system integration, and wellness goals. I&I help prevent and reduce risks to achieve operational performance and mission success. Within the three major risks of microgravity, radiation and isolation, I&I support a wide range of risks, such as, Spaceflight Associated Neuro-ocular Syndrome (SANS), the CBS Integrated Research Plan, structural brain changes, sleep loss and circadian desynchronization, altered immune response, and the important area of post flight recovery.

The terms Interogenesis & Interoception (I&I) are currently not listed in NASA's Task Book. Many practices and principles exist in space agency astronaut training programs to develop these principles, yet it is proposed, astronaut training will be more efficient and effective with a transdisciplinary refinement and organization of these principles. Interoception is an existing concept under research since the early 1900's, and is currently a hot topic at the National Institute of Health. Interogenesis is a new term and transdisciplinary concept that aggregates and refines existing, historical principles across the arts and sciences. (Lappin, 2020).

I&I are high-touch, low tech, user-driven, empowered, personalized patient engagement that are close to the patient's point of need. The astronaut's ability to self-train personal biomarkers add data to the feedback loop in the health continuum spectrum. I&I are aspects of biological communication that parallel technological communication. They are an advance in biological measurement and integrated anatomy and physiology across silo-ed disciplines, such as, psychophysiology, health, cognition and behavior, performance, fitness, psychoneuroimmunology, relationships-teamwork, and stress-resilience.

I&I tactics refine our ability to perceive, construct and regulate internal inner space signals and states. They work in conjunction with remote sensing and AI driven diagnostic clinical support. They are biologically analogous to technologies such as an Magnetic Resonance Imaging, SPECT Imaging, Transcranial Magnetic Stimulation, Vegus Nerve Stimulation, or Deep Brain Stimulation. As well, I&I are back-up skills to be utilized should in-flight clinical diagnostic technology fail.

The I&I framework includes: A) Insight to help solve a historical oversight in basic physical and biological science that reveals clues into the evolution of mammalian brain development and the volitional, attentional control of deep internal psychophysiology. B) The evolution of measurement principles across transdisciplinary arts and sciences and their influence upon the field of health information technology. C) An edge case study of an acquired savant with a complex medical condition that reflects astronaut health risks. D) Observations of patients with chronic illnesses. E) Application of NASA funded astrobiology research for the cellular origin of life into HHR-CBS solutions. F) A prevention framework to address multi-stressor risks to operationally relevant brain and visceral organ pathways. G) Systems biology inquiry and volitional signal mobilization at the level of immunology and a virus (i.e. Covid-19 vaccine R&D solution).

I&I tactics include: 1) Shift attention from external to internal, from cognition to systems biology; 2) Map personal, internal psychophysiology biomarkers, from macro to micro. 3) Train baseline awareness of biomarkers. 4) Regularly measure against baseline. 5) Train and initiate internal force/work signal generation to stimulate/switch target tissue or pathway. 6) Integrate psychophysiology, recover, and return attention to cognition and external attention.

ISS/UN/WHO/IOC collaboration supports Covid-19 vaccine R&D, ISS promotional and commercialization: An immediate opportunity exists to test I&I in a simplified earth analogue to support of Covid-19 vaccine R&D. It would extend current space agency efforts in support of the pandemic. This analogue would be a stepping stone towards R&D on the ISS. The collaboration would be with current Covid-19 vaccine developers to test vaccine effectiveness. This test protocol would use I&I curriculum combined with an abbreviated NASA/ISS astronaut performance training curriculum to support healthy immune response during early stage vaccine testing. The I&I Inner Space hypothesis is that the combined curriculum will increase Covid-19 vaccine safety and effectiveness, and reduce adverse side effects. This is important given the uncertainty due to the 'warp speed' of R&D necessitated by the pandemic. This protocol is an extension of existing, successful validated research of cofactors of vaccine effectiveness – therefore low risk. When successful, this tactic would roll out globally as a collaboration, where space agencies/ISS could join the existing collaboration between The United Nations, The World Health Organization and The International Olympic Committee to promote Covid-19 related health and fitness. Additional partners could include: Nike Int'l, The Walt Disney Company, and Ford Motor – who are potential future commercialization partners of the ISS R&D. All these organizations are current or past collaborators with NASA. This initiative supports the broad international promotional and commercialization goals of ISS.

ISS Research: The I&I curriculum will integrate across existing training begin early in an astronaut's career. The ISS R&D phase will implement the methodology in-line with existing and future autonomous healthcare, self-care, prevention and countermeasures, in conjunction with clinical diagnostic technology.

Commercialization: The Interogenesis & Interoception model addresses an underserved therapeutic process that is a countermeasure to a broad range of health burdens that constitute a significant portion of total healthcare costs and mortality on earth. It fills a critical gap in Western Medical practice, when applied across the health continuum from pre-natal, familial and pediatric health to adult illness, to hospice care. I&I helps solve inefficiency in the entire healthcare system that arises from the past 100 years of medical education in the United States (i.e. the 1910 Flexnor Report). Applications include: adult complex medical conditions, stroke rehabilitation, cardio-vascular disease, immune and inflammatory co-factors, stress and illness, elder care, and the dark under current of mental health. In their advanced training format, I&I are packaged as a sensory-rich computer animation of psychophysiology. Commercial potential includes medical therapeutic process, healthcare worker

wellness training, family and child education, sports training, employee wellness and fitness training, mental health therapy, relationship psychotherapy, and a consumer animated entertainment film. Inner Space is a new frontier.