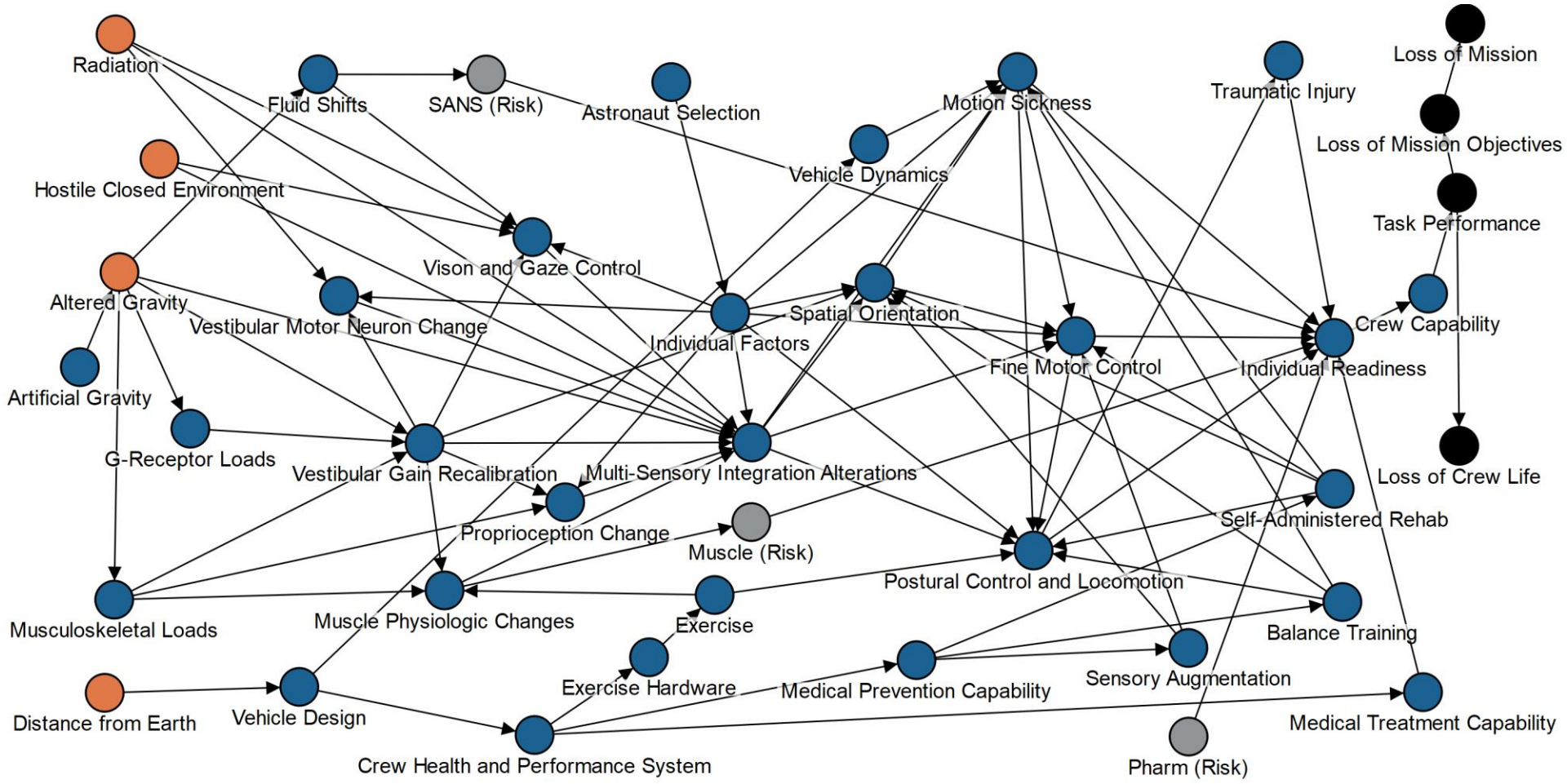
Sensorimotor Risk DAG Narrative

- The Sensorimotor Risk is primarily derived from **Altered Gravity** environmental changes but also has effects from **Radiation**, **Hostile Closed Environment, and Distance from Earth**.
- Transitions to/from **Altered Gravity** environments have physical effects on the body:
  - **Fluid Shifts** – fluids shift between the lower body and the upper body.
  - **Musculoskeletal Loads** – physical loading/unloading of the musculoskeletal system.
  - **G-Receptor Loads** – changes in linear accelerations, including gravitational, acting on the G-receptor organs.
- These changes lead to physiological changes that affect:
  - **Vestibular Gain Recalibration -** the relationship between accelerations, including gravitational, and vestibular responses.
  - **Vision and Gaze Control** - vision is the ability to see and gaze control is the ability to orient the eyes, and maintain fixation, on a desired visual target. **Radiation** can induce cataracts that affect vision.
  - **Vestibular Motor Neuron Changes** - vestibular neurons adapt to reduced or increased firing rates and become more or less sensitive. **Radiation** and the **Hostile Closed Environment** are suspected to affect motor neurons.
  - **Proprioception** - a global term that encapsulates multiple internal sensors that monitor the position and movement of body segments relative to each other. This is often grouped with skin tactile sensation.
  - **Muscle Physiologic Changes** - reduced loading on muscle, tendons, and ligaments that cause both structural and functional **changes in strength.**
- All of these physiological changes alter the signals that must be interpreted by the brain and here is represented by **Multi-Sensory Integration Alterations**. **Radiation** and the **Hostile Closed Environment** effects on the central nervous system is suspected to affect this central processing.
- The central nervous system must integrate information from all of these systems. **Multi-Sensory Integration Alterations** can affect functional abilities and lead to impairments:
  - **Motion Sickness** occurs when vestibular and visual signals in the brain are conflicting.
  - **Fine Motor Control** limits the ability to perform tasks that require delicate control.
  - **Postural Control and Locomotion** refer to upright balance and the ability to walk that are required to perform physical tasks in a gravity environment.
- The severity of these functional impairments directly impacts **Individual Readiness** and **Crew Capability** and specific tasks including:
  - **Manual Control of Vehicles** which depends on **Fine Motor Control** and spatial orientation/perception.
  - **EVA (Risk)** through the increased likelihood of falls or injury.
  - **Crew Egress (Risk)** through the increased likelihood of falls or injury.
- These affect **Individual Readiness**, **Crew Capability** and through them **Task Performance** and other Mission Level Outcomes.
- **Distance from Earth** affects the mass, power, volume, and bandwidth allocations for **Vehicle Design** and the **Crew Health and Performance System** in particular. These include:
  - **Exercise Hardware** and **Exercise** which affects **Muscle Physiologic Changes** and **Postural Control and Locomotion**.
  - **Medical Treatment Capabilities** such as motion sickness medications.
  - **Medical Prevention Capabilities** such as the following countermeasures that are still experimental:
    - **Self-Administered Rehab**
    - **Sensory Augmentation**
    - **Balance Training**
  - **Pharm (Risk)** can include motion sickness medications such as Meclizine, Promethazine, Scopolamine, etc. that are susceptible to stability issues**.**
- **Artificial Gravity** as a countermeasure holds the potential to significantly reduce the Sensorimotor Risk but is high cost to implement.


Radiation
Fluid Shifts
SANS (Risk)
Astronaut Selection
Motion Sickness
Traumatic Injury
Loss of Mission
Loss of Mission Objectives
Hostile Closed Environment
Vehicle Dynamics
Task Performance
Vison and Gaze Control
Altered Gravity
Vestibular Motor Neuron Change
Spatial Orientation
Crew Capability
Individual Factors
Fine Motor Control
Individual Readiness
Artificial Gravity
G-Receptor Loads
Vestibular Gain Recalibration
Multi-Sensory Integration Alterations
Loss of Crew Life
Self-Administered Rehab
Proprioception Change
Muscle (Risk)
Postural Control and Locomotion
Musculoskeletal Loads
Muscle Physiologic Changes
Exercise
Balance Training
Exercise Hardware
Medical Prevention Capability
Sensory Augmentation
Distance from Earth
Vehicle Design
Medical Treatment Capability
Crew Health and Performance System
Pharm (Risk)