OPTIMIZING THE COMBINATION OF INTRANASAL SCOPOLAMINE AND SENSORY AUGMENTATION TO MITIGATE G-TRANSITION INDUCED MOTION SICKNESS AND ENHANCE SENSORIMOTOR PERFORMANCE

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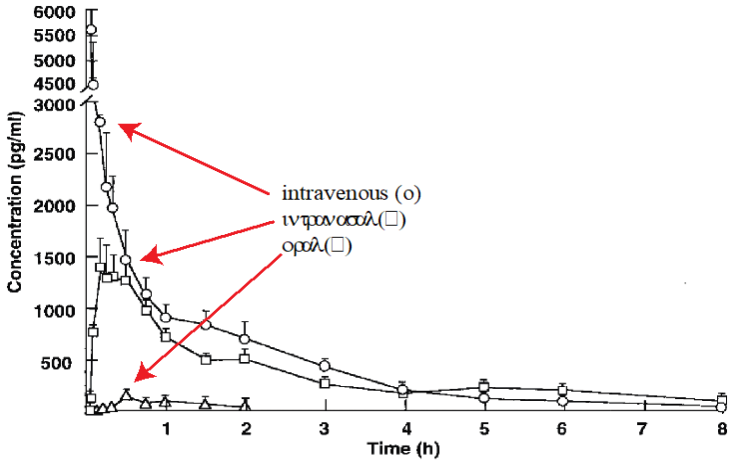
Background

- There is a high incidence of reentry motion sickness following long duration spaceflight, and water landings may impose greater risks for reentry motion sickness.
- Historically, anti-motion sickness medication has been operationally challenging to optimize dosage levels when administered on orbit prior to landing.
- Intranasal scopolamine (Inscop) was developed at NASA (Lak Putcha)
  - Nasal pump can be used to self-administer drug while suited (before or after landing for additional dosing)
  - Nasal formulation provides rapid bioavailability with minimal side effects
- Providing an Earth-fixed reference is a non-pharmaceutical orientation aid during capsule wave motion and egress
  - Sensory augmentation (vibrotactile feedback) has been effective as spatial awareness and balance aids in similar conditions
  - Tactor belt using body worn IMU has the advantage of providing an Earth-fixed reference that moves with you during capsule egress



Scopolamine bioavailability (adapted from Putcha, 1996)

Specific Aim & Hypothesis

- Evaluate combining intranasal scopolamine and sensory augmentation as an integrated countermeasure intended to mitigate motion sickness and enhance crew performance.

Hypothesis

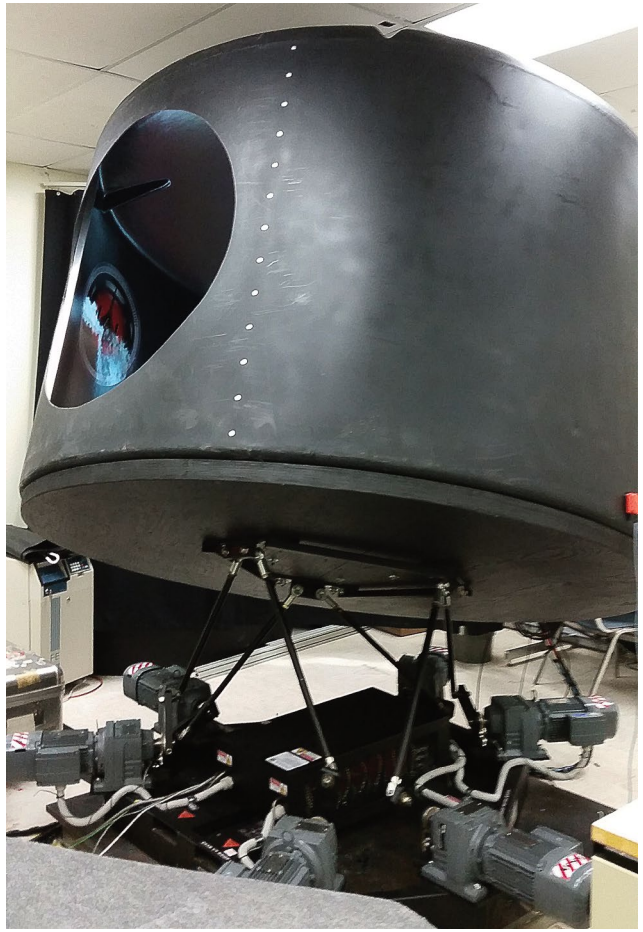
The combination of intranasal scopolamine and sensory augmentation of Earth vertical will be more effective to mitigate motion sickness and improve task performance than when administered separately.

Inscop

Tactor feedback belt as Sensory Augmentation (SA)

Methods

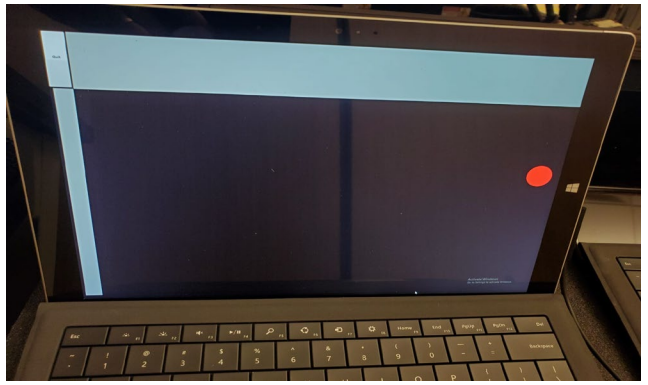
- Exposure to simulated capsule wave motion on a six degree-of-freedom (6DOF) platform will be used to induce motion sickness and impair performance on functional tasks.
- Intranasal scopolamine (Inscop) and sensory augmentation (SA) of Earth vertical will be administered separately or in combination during different sessions
- Using a randomized double-blind repeated measures crossover design, we will compare motion sickness symptoms and functional performance during and following exposure to simulated wave motion on a 6DOF platform inside of a crew capsule mockup

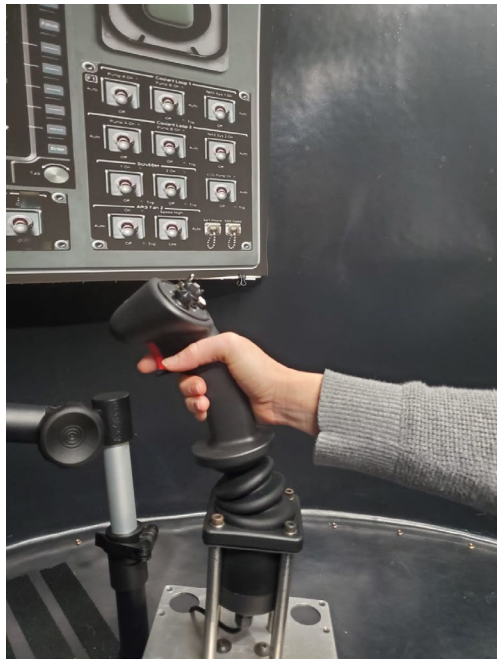


6DOF motion platform

Methods

- Performance on a series of functional tasks will be performed pre, during, and post simulated wave motion.
  - Perceptual measures of upright using a joystick
  - Dual tasking – same joystick measures while performing Paced Auditory Serial Addition Test (PASAT)
  - Eye-hand coordination on a tablet
- Cognition (psychomotor vigilance test), alertness self-rating (Stanford sleepines scale), and subjective reports of drug side effects will be obtained.
- Bioavailability of scopolamine for each session will be estimated from plasma concentrations (samples at 15 min spacing).





Relevance

Our project will deliver recommendations on the operational efficacy of combining intranasal scopolamine with sensory augmentation for mitigating motion sickness while minimizing side effects and maintaining crew performance during recovery.