# Sensory supplementation to enhance adaptation following G-transitions and traumatic brain injury


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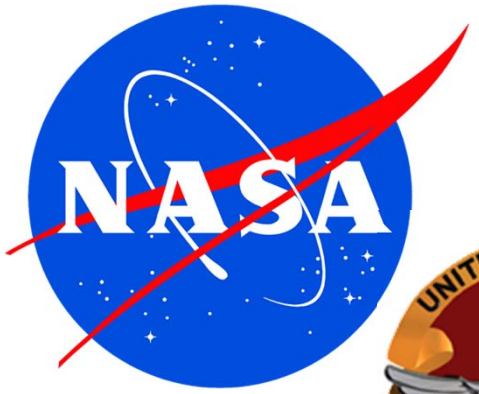



Towards Integrated Countermeasures
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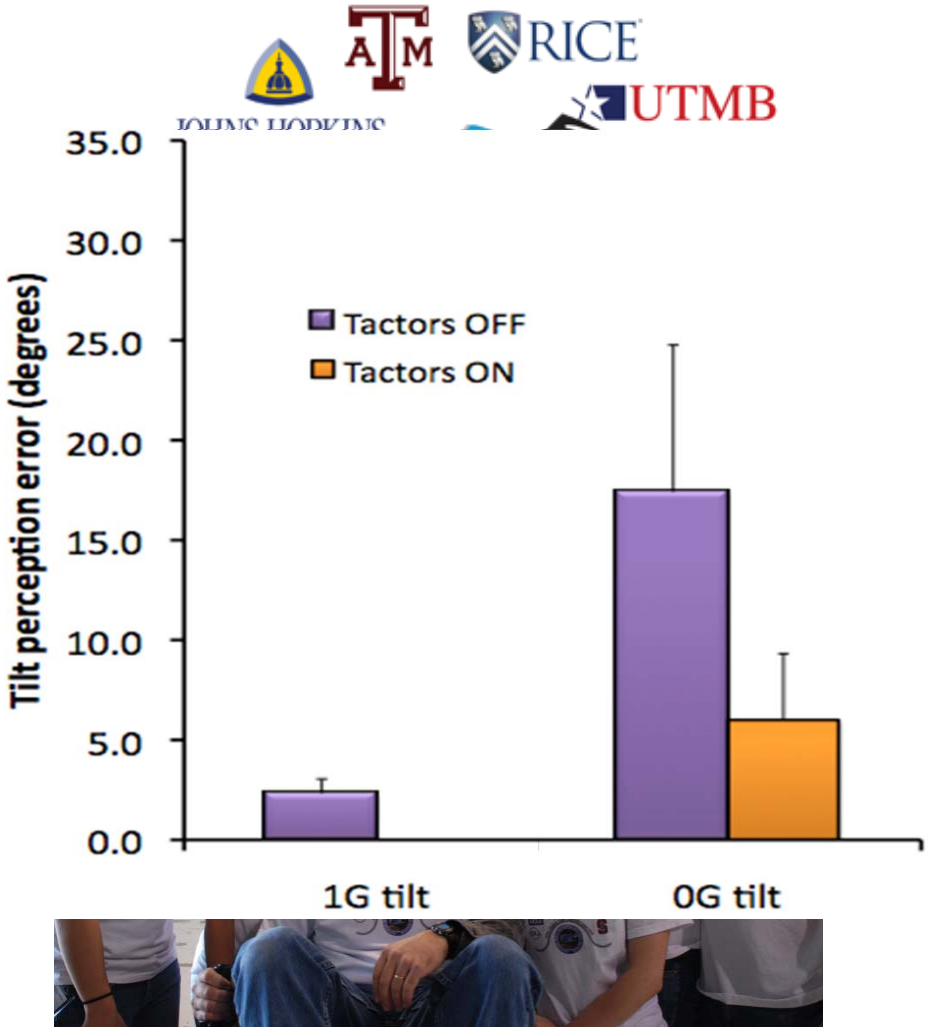
# Sensory supplementation

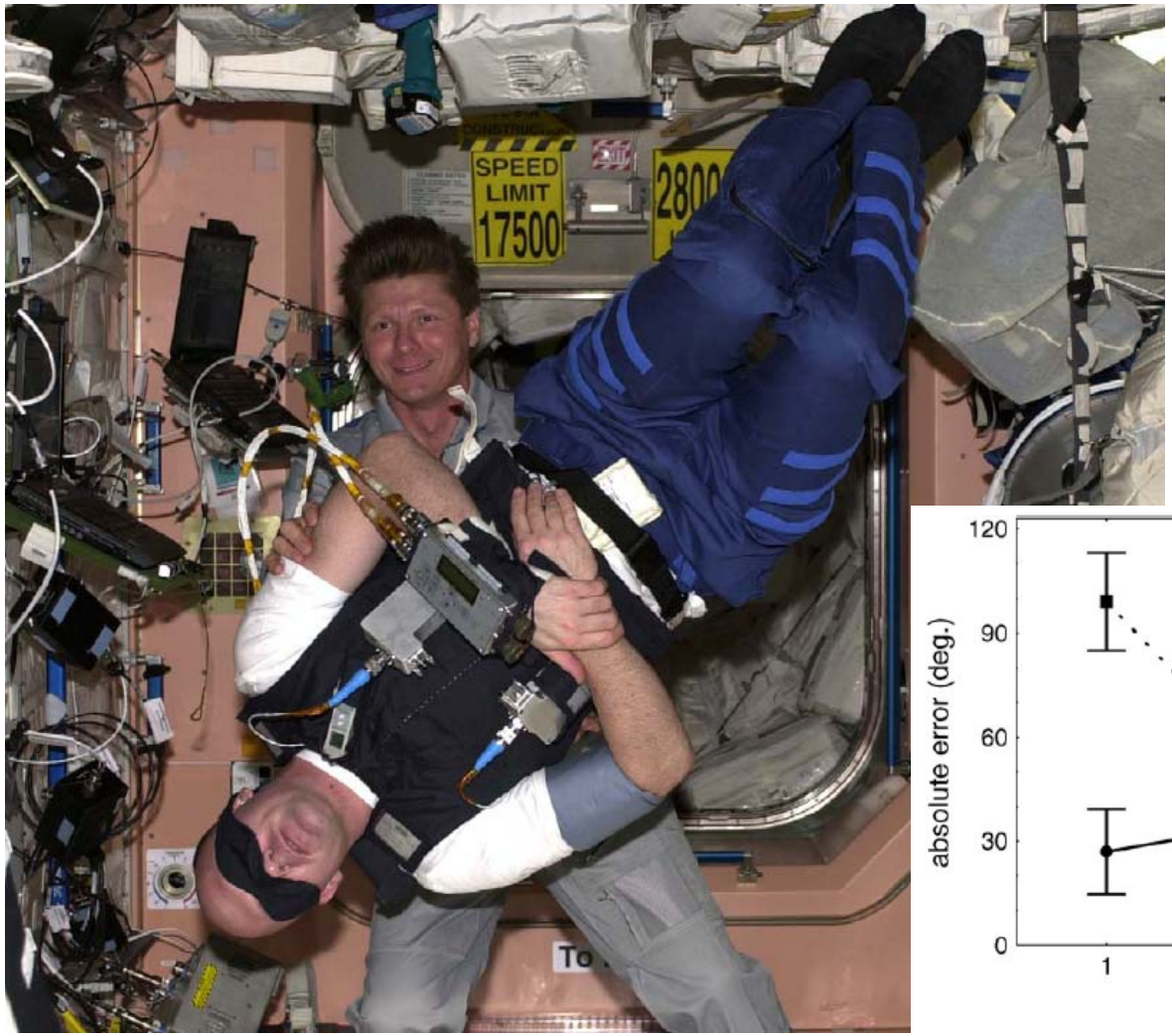
- Using natural senses (touch, sight, hearing) to display information intuitively from physical sensor
- Focus is on reinforcement of accurate sensory information rather than enhancing signals (stochastic resonance) or substitution (prosthesis)

# Tactile Situation Awareness System

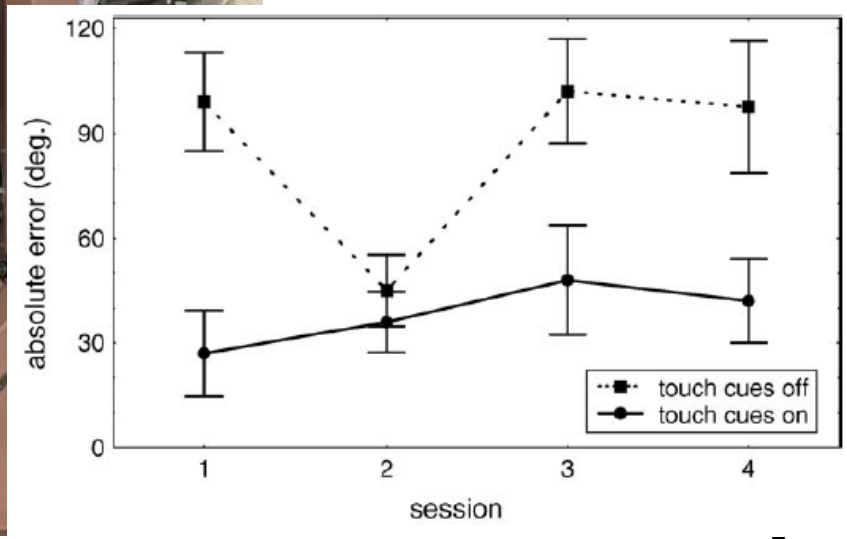
# Parabolic Vibrotactile Experiment



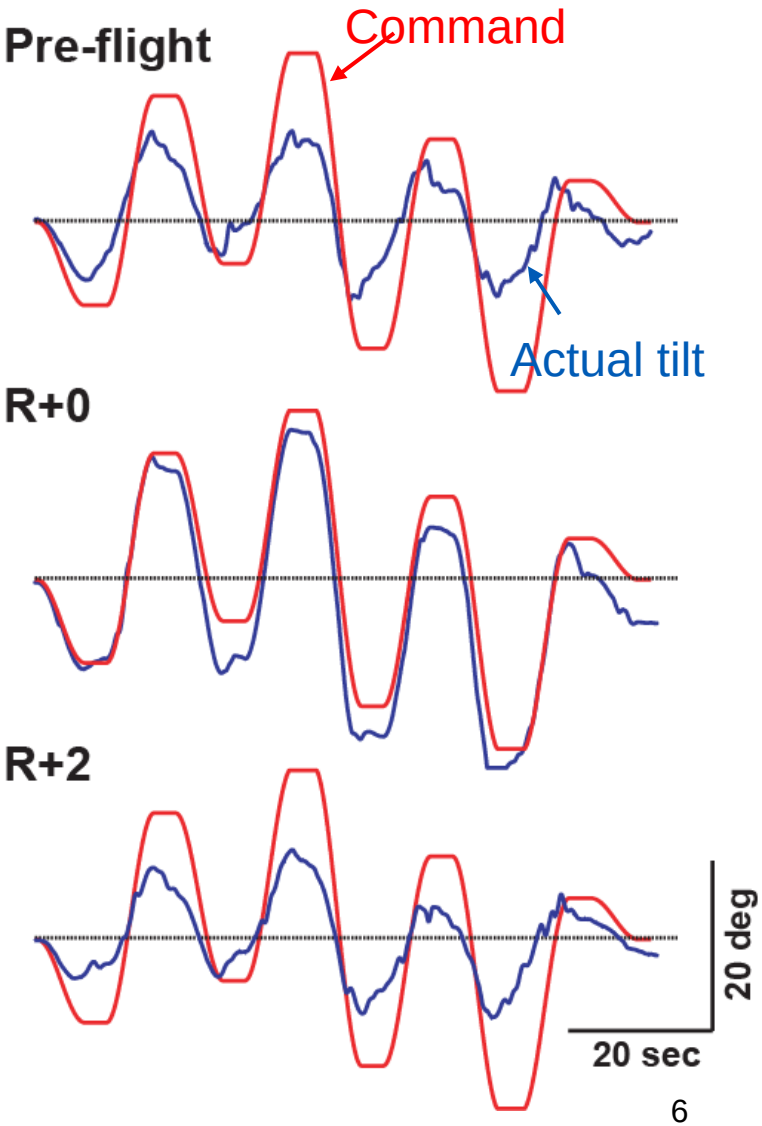
# ISS Vibrotactile Experiment




**Days 2, 3, 6 & 7**
**van Erp & van Veen**
**(Neurosci Lett 2006)**



# Shuttle ZAG experiment – Clément



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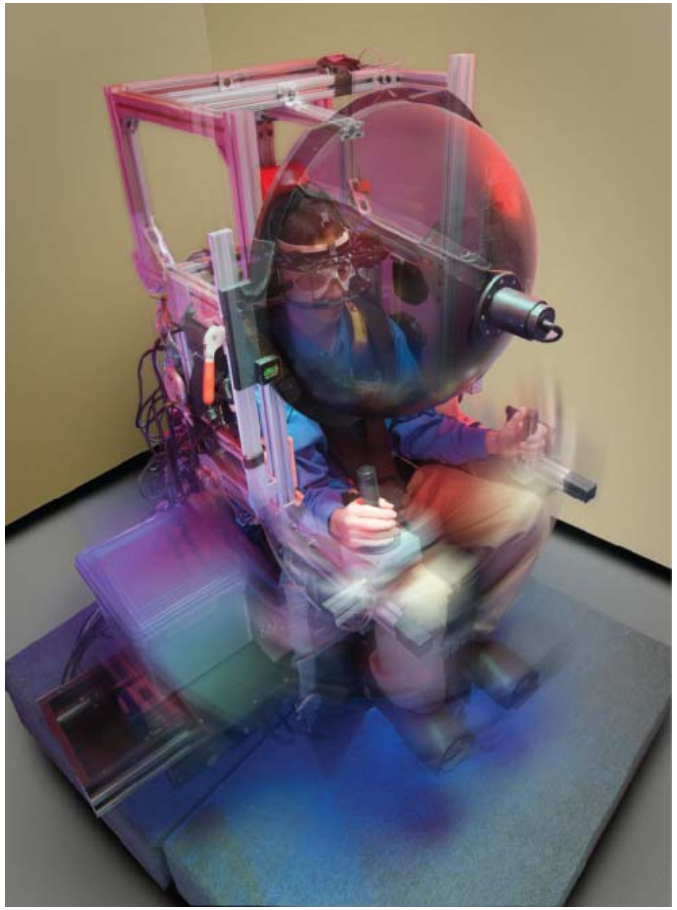
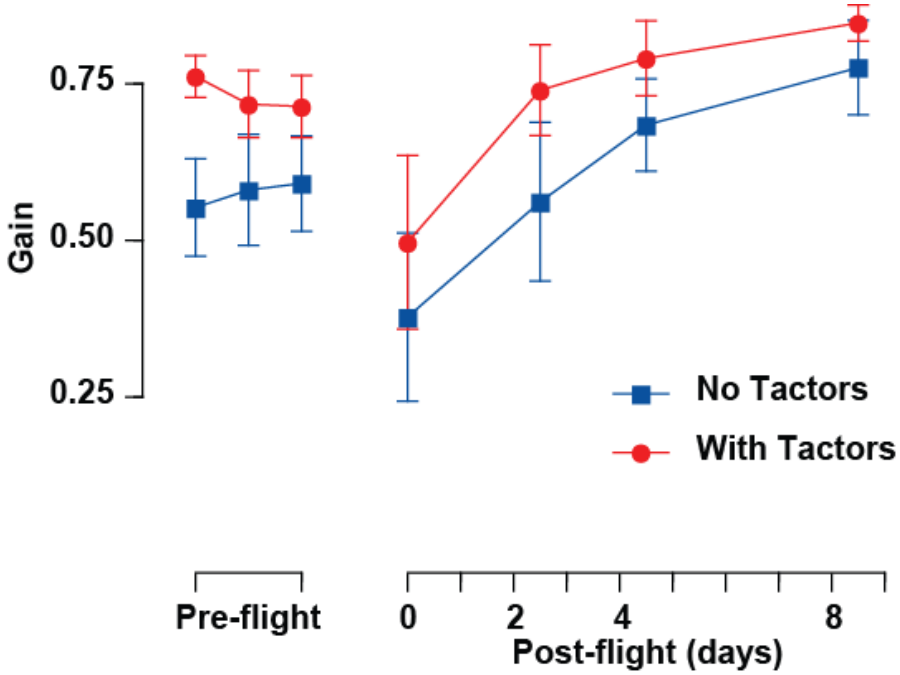


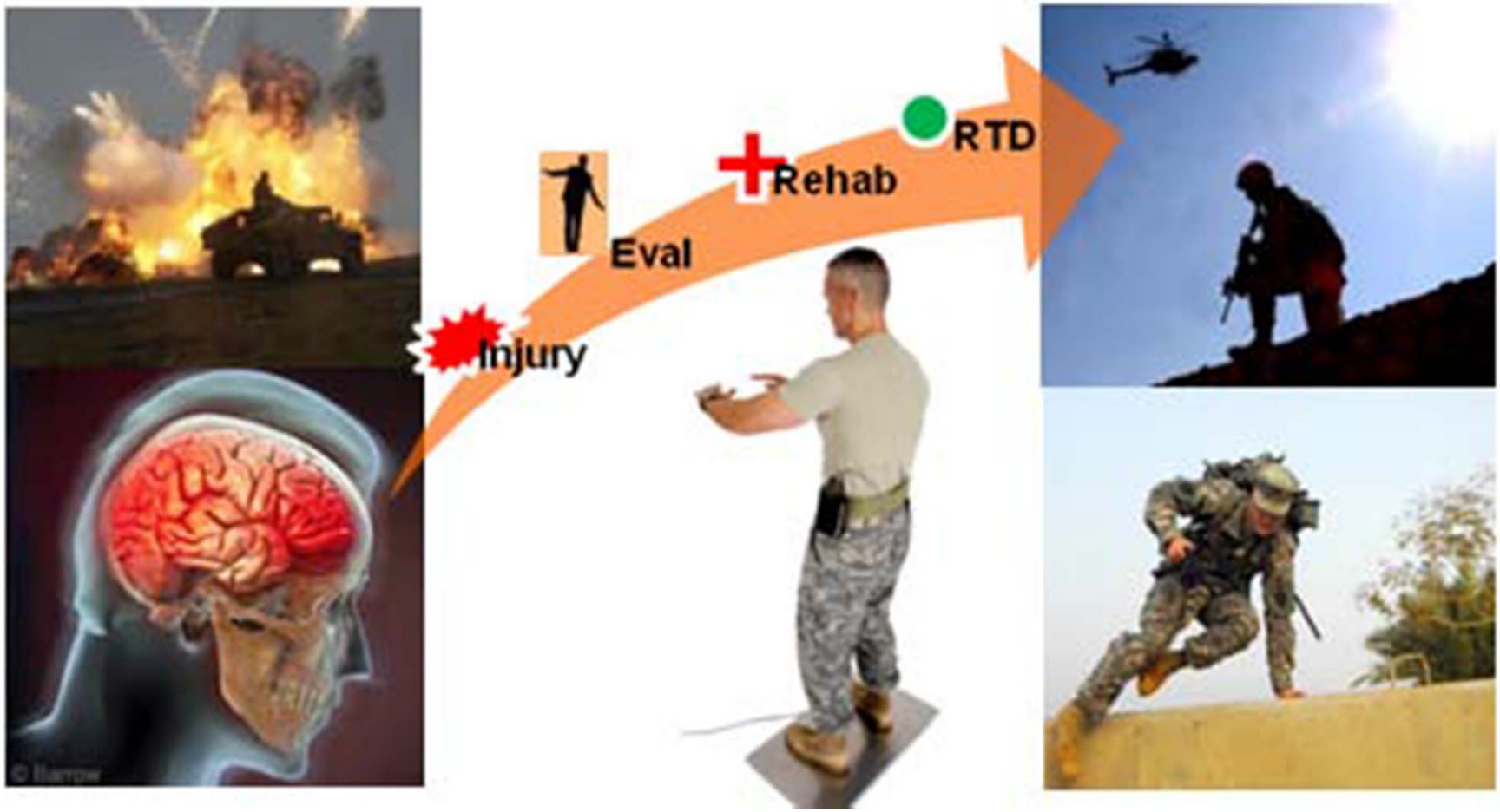



- **Performance improved with tactors**
- **R+0 with tactors similar to preflight without**



Clément & Wood, Acta Astronautica (2013) 92:48–52

# Traumatic Brain Injury (TBI)



# Increased sway following TBI

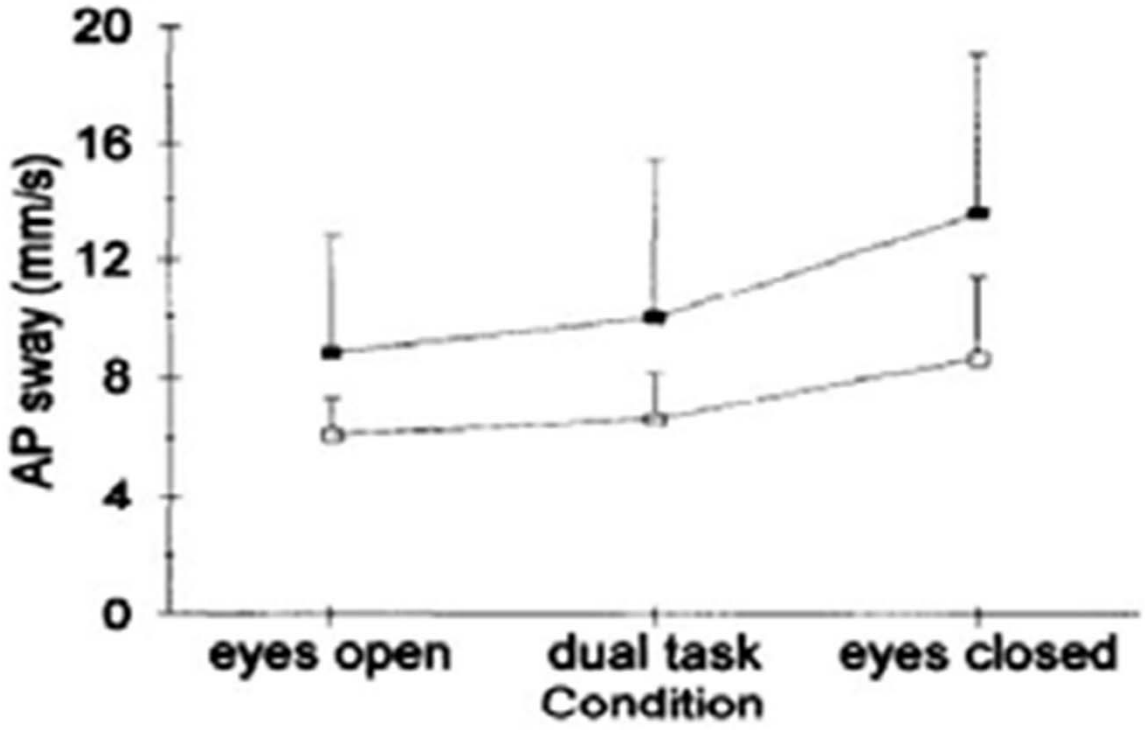
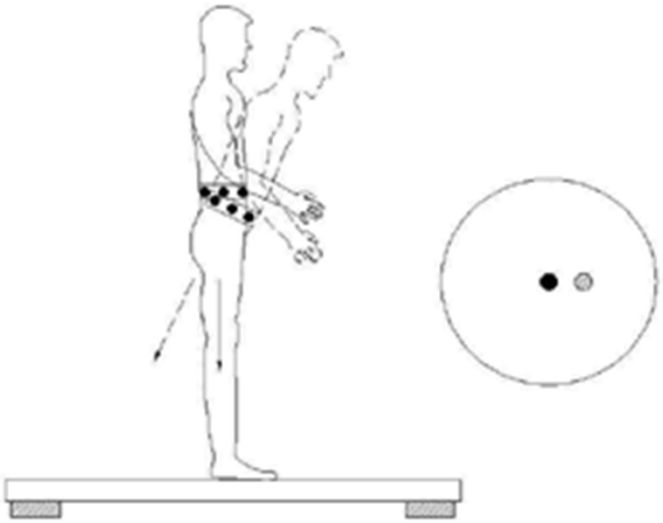
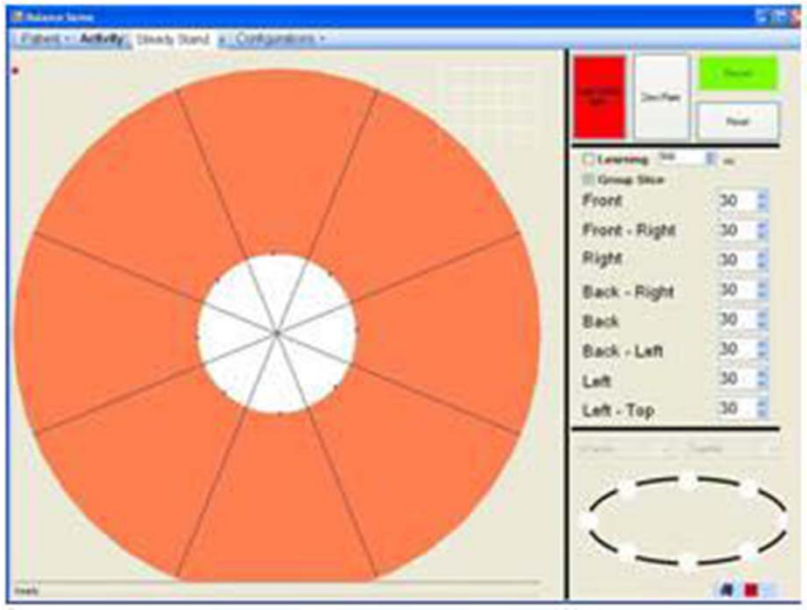
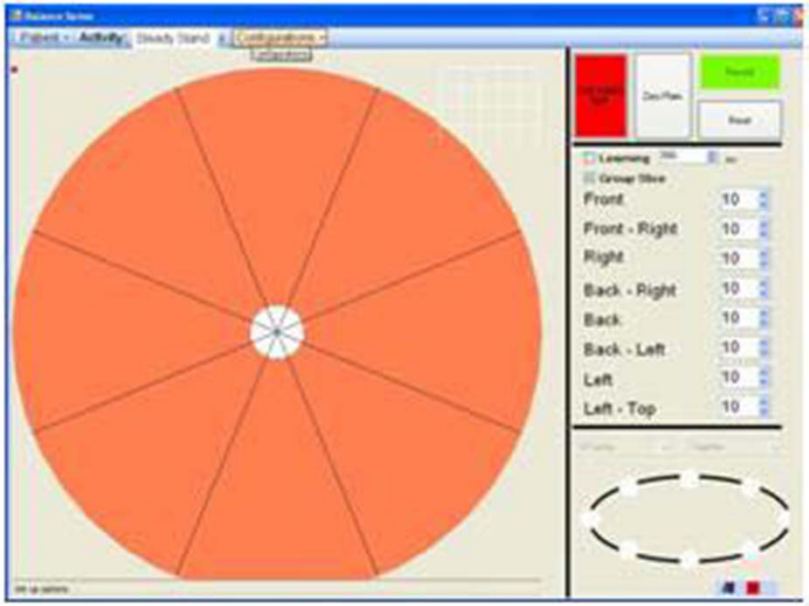



Fig 2. The group means and SDs of the RMS CP velocity in the antero-posterior (AP) direction are shown for both the TBI group (■) and the control group (□) in different conditions (N = 20).

# Balance Sense belt

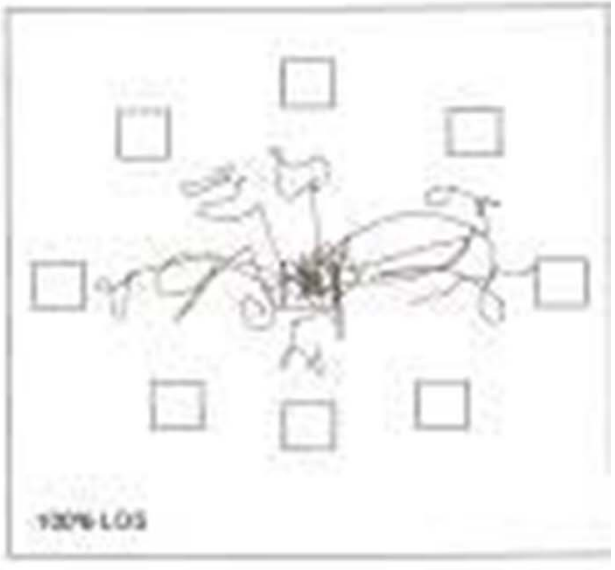




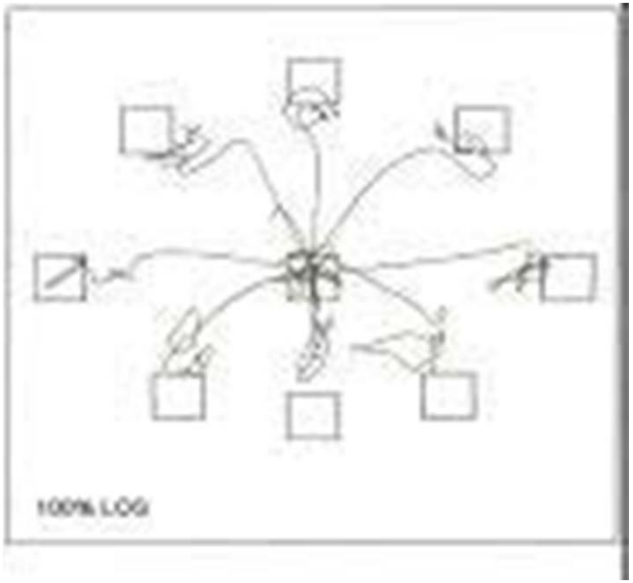



# Limits of stability test

Before rehab

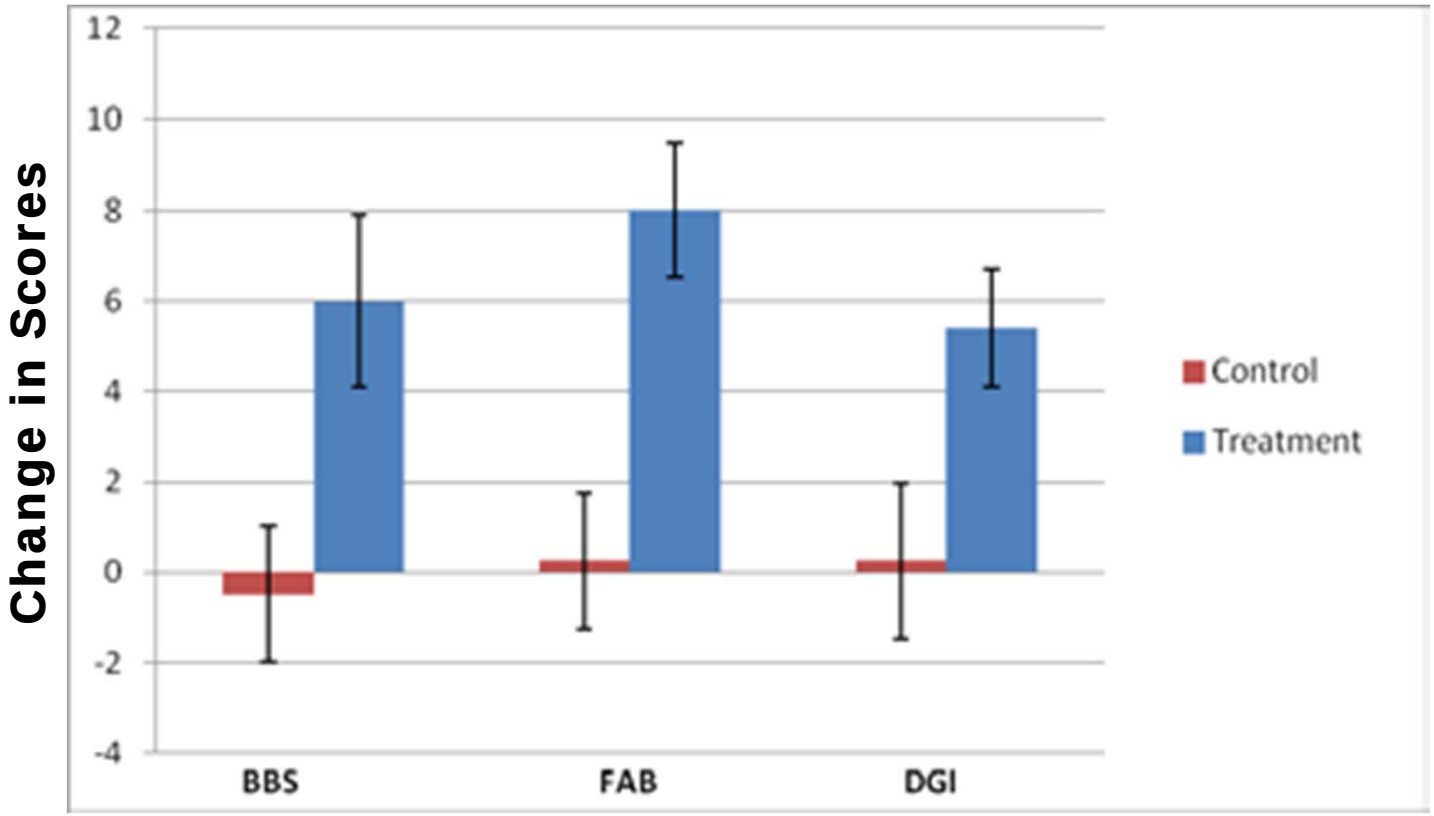


After tactile training



(from Akins, 2010)

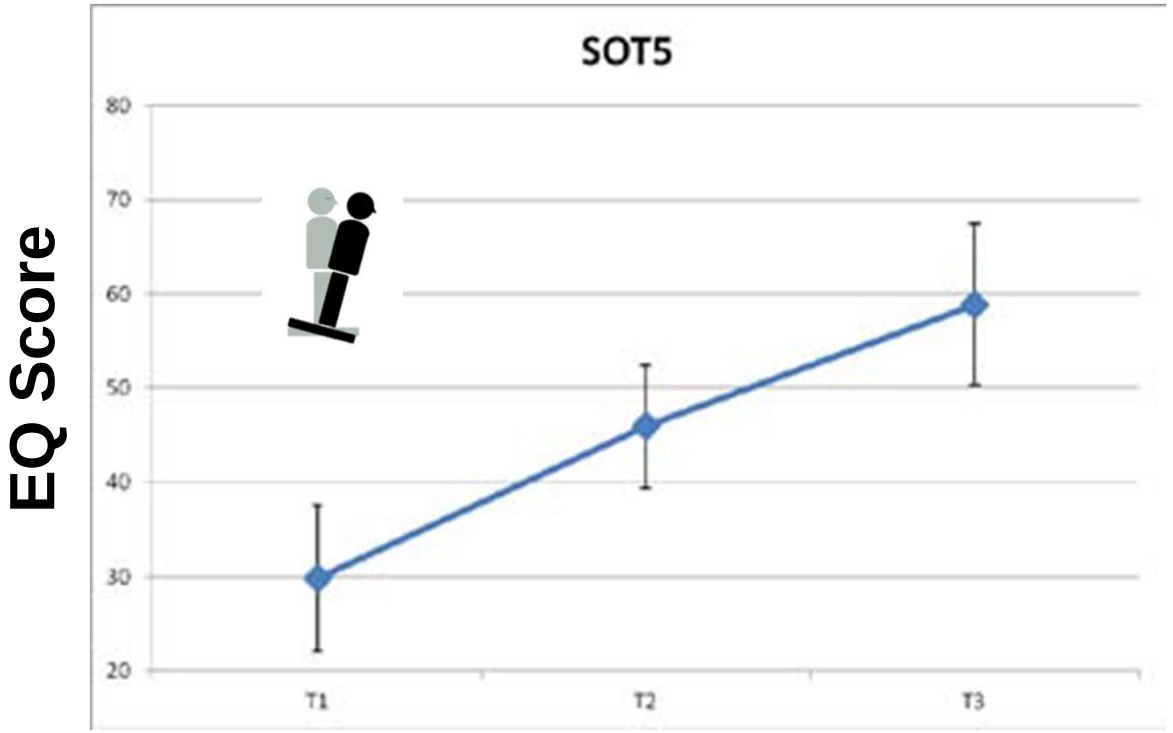
# Tactile training in elderly patients




BBS = Berg Balance Scale
FAB = Functional Assessment Battery
DGI = Dynamic Gait Index
(from Akins, 2010)

# Tactile training in TBI patients


**Eyes closed, unstable support**




**EQ Score**

**Treatment Session**

(preliminary data from Rupert et al., 2013)

# Summary

- Sensory supplementation can be incorporated as online feedback for improving spatial orientation awareness for manual control tasks (e.g. TSAS, Shuttle ZAG study)
- Preliminary data with vestibular patients and TBI military population is promising for rehabilitation training
- Recommend that sensory supplementation be incorporated as a training component in an integrated countermeasure approach