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

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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

![Image of people during experiment]

![Bar graph showing tilt perception error (degrees) with and without tactors]

- Taptors OFF
- Taptors ON

1G tilt vs 0G tilt
ISS Vibrotactile Experiment

Days 2, 3, 6 & 7
van Erp & van Veen
(Neurosci Lett 2006)
Shuttle ZAG experiment – Clément

Command

Pre-flight

 Actual tilt

R+0

R+2

20 sec

20 deg
Shuttle ZAG experiment – Clément

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

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

After tactile training

Before rehab

(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

Treatment Session

(Eyes closed, unstable support)

(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