What did neuroergonomics tell us about the impact of different control devices in the spaceflight context?

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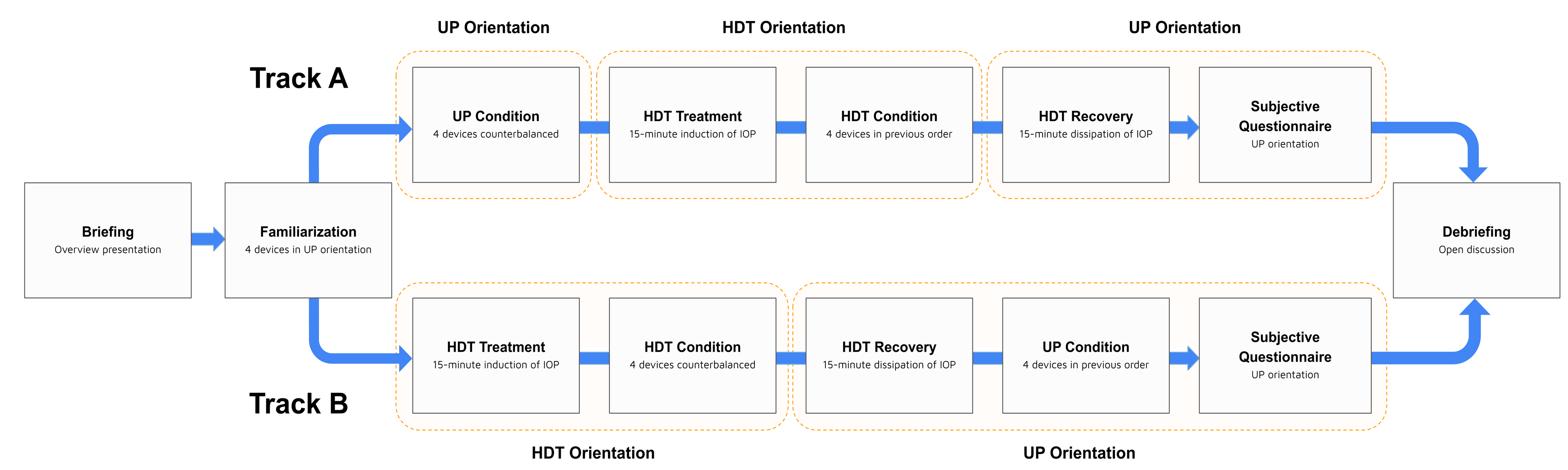
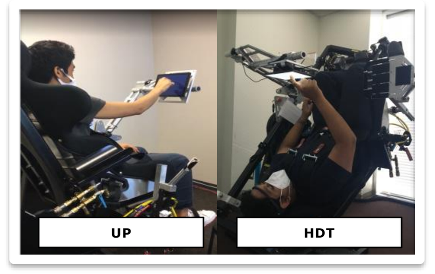
Our research problem was to understand the effects of different cursor control devices (CCDs) on spaceflight participants in different spacecraft orientations. We used neuroergonomics to study the brain and behavior in work contexts by examining electroencephalography (EEG) indices related to cursor control task performance, i.e., concentration, relaxation, effort, fatigue, arousal, valence, and absorption.

Flow of the Experimental Sessions for Tracks A and B

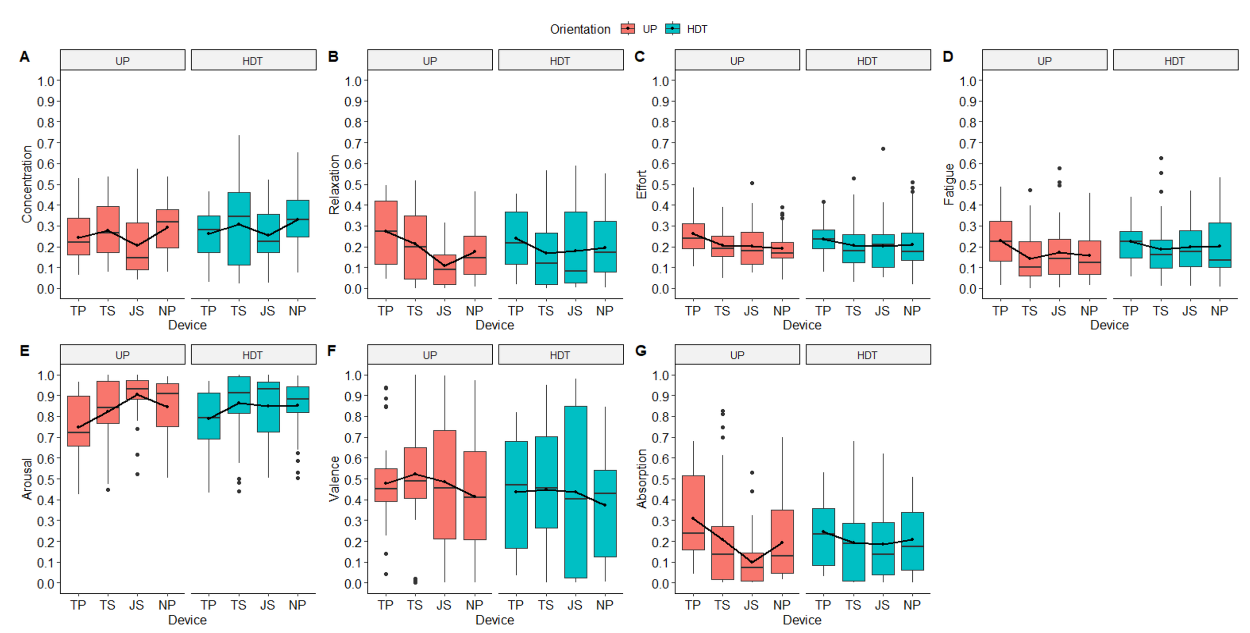


Adaptive Spaceship Cockpit Simulator Orientations

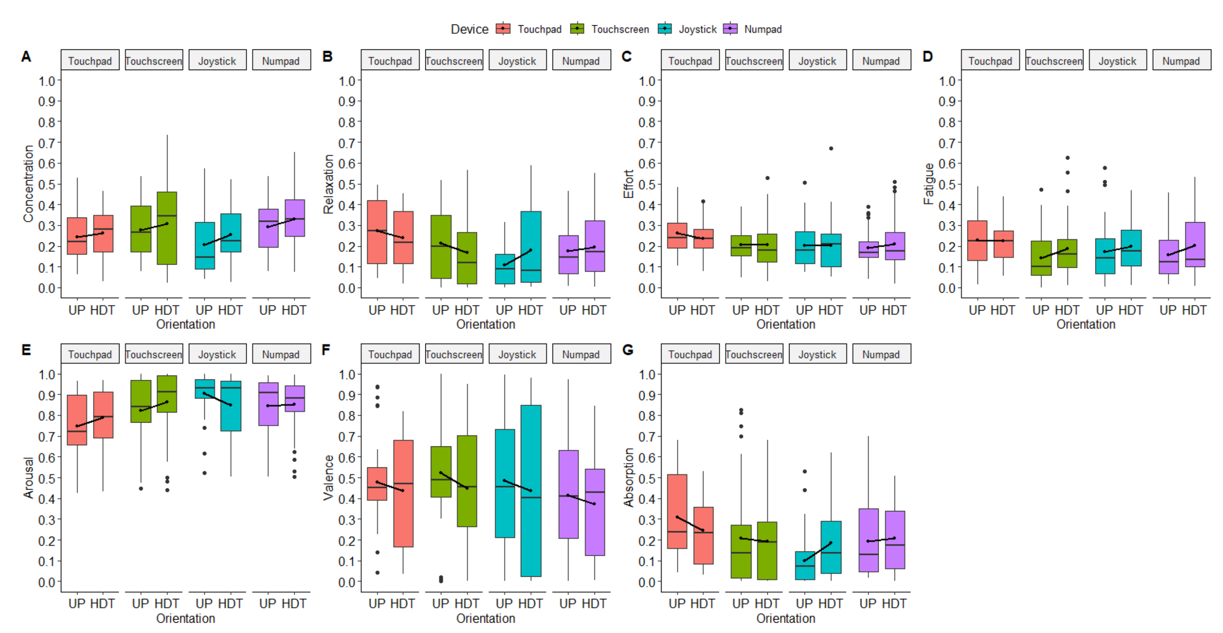


Cursor Control Devices

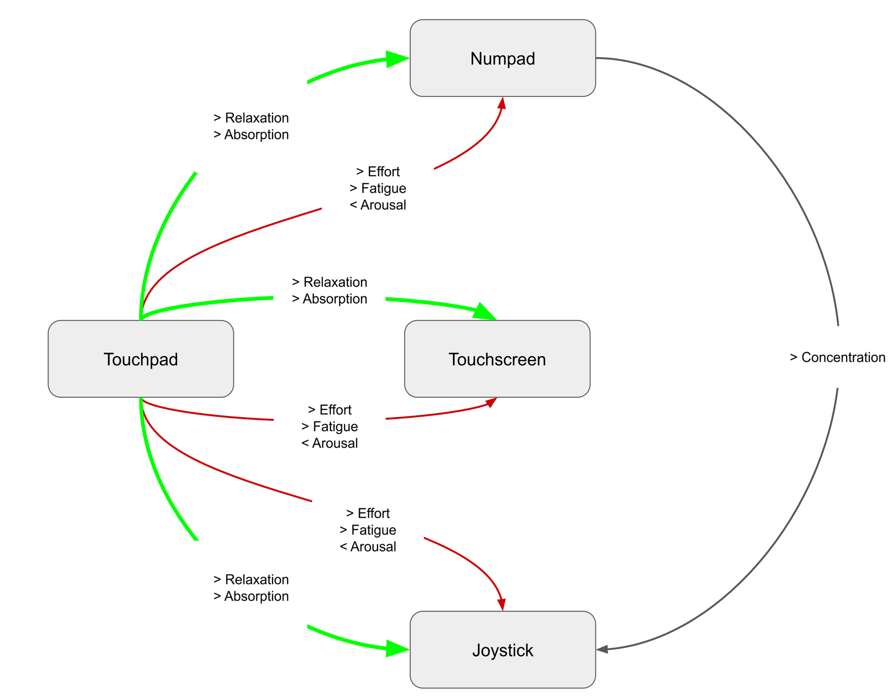
Effects of Orientation on the EEG Indices



Effects of Device on the EEG Indices



Pairwise comparisons of the CCDs



The cursor control task was based on Fitts law, and trials involved controlling the cursor with the CCD to click on the starting square followed by the target square. The display presented randomized target squares of varying sizes and distances from randomly sequenced starting positions.

N=27 participants, M=22.5 years, SD=5.2. Six participants were excluded from analysis due to incomplete data.

- HDT caused more concentration, $F(1,19)=7.06$, $p<.01$, $\eta^2=0.02$
- HDT caused more fatigue, $F(1,19)=4.31$, $p<.05$, $\eta^2=0.01$
- No significant interactions between orientation and other variables

The type of device significantly affected the following EEG indices:

Concentration	$F(3,17)=8.03$	$p<.01$	$\eta^2=.02$
Relaxation	$F(3,17)=10.09$	$p<.001$	$\eta^2=.08$
Effort	$F(3,17)=6.48$	$p<.005$	$\eta^2=.005$
Fatigue	$F(3,17)=6.46$	$p<.001$	$\eta^2=.05$
Arousal	$F(3,17)=13.00$	$p<.001$	$\eta^2=.10$
Absorption	$F(3,17)=10.96$	$p<.001$	$\eta^2=.08$

The touchpad was associated with higher levels of relaxation and absorption than the other three devices even though it induced more effort and fatigue with less arousal than the other three devices. This trade-off is acceptable since the increased effort and fatigue with touchpad may be the cost of performing with higher absorption.

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Neuroergonomics of Cursor Control Devices in Spacecraft Cockpits for Spaceflight Participants

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