“HRV in the air”: What data from top gun pilots tells us about physical and mental workload?

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„in service of nation”
Military service job (especially flight) is really challenging for almost every soldier (including special forces):

the excessive energy demands (both physically and mentally) caused by special deployments and missions can provoke autonomic imbalance, POSSIBLE ROLE in acute incapacitation characterized by a hyperactive sympathetic system and a hypoactive parasympathetic system which finally can lead to premature aging and diseases.
AEROMEDICAL STRESSORS

accelerations - overloads

Ionizing and high frequency radiation

hypo / hyperthermia

noise

hypoxia

spatial disorientation

vibration

motion sickness
BEYOND THE CURVE … - INFORMATION WAR

- Basic flight
- Psychophysiological stress
- Capabilities / skills

WORKLOAD vs. Time (years)
ambulatory & real Holter ECG
hypoxic tolerance exams
orthostatic tolerance measurements
Pressure breathing tests
GYRO lab simulator
centrifuge runs
Aeromedical aspects

- accelerations
- psychic stress
- physical stress
- vibration

vegetative dystonia in CNS

change in perfusion

hypoxaemia

Neurohumoral activation

CO, ectopic activity, myocardium depression
Stress tolerance? Mind set vs. skill set?

Ground-based simulation

Psychology Cognitive test battery

Barochamber + Cognitive test battery

1st Lt. Lea ZOLNAI
1st female transport pilot on A319

Real Flight?

Virtual Reality?

Barochamber + Virtual Flight

LAB into REAL WORLD!
1. As a system – simple deployable
2. As a software – straightforward evaluation, edition of graphs with splitters
3. Durability - hypoxia, G loads (G sensor up to 9 Gz-s)
4. Simulation - +VR/VE technology –
5. Real flight – monitoring system (with synchronized data?)
6. Psychic trauma (ejection – regeneration/recovery?)
7. Pilot work related stress (mental or physiological)
The Canadian Armed Forces (CAF) is undertaking a major research initiative with the help of Firstbeat Lifestyle Assessment. **Dr. Julie Martin** of the Directorate Fitness Team is overseeing the study that will use *real-world measurement data* to investigate the physiological impact of participants’ daily life and will be used to better understand fitness related topics across the CAF. (2017. March)

**FINNISH AIR FORCE – „hi-fi” simulator study**

EU GINOP PROJECT: NIRS + VR

NIRS: Near Infrared Spectroscopy
VR: Virtual Reality
JAS-39 Aircrew Equipment Assembly

Type 116E Helmet

Oxygen Mask 127B

Survival Jacket 39

Anti-g Garment 97C/K

Gripen Boots

FIRSTBEAT
BODYGUARD2
FIRSTBEAT BODYGUARD2
GRIPEN fighter pilot’s working day

Flight sortie:
1. Low altitude target flight for interception 2x
2. Aerobatics up to 9 Gz

- Intensive recovery
- Conditioning effect
- Strongest stress response
- Training flight
- Light housework
FLIGHT:
1. Low altitude target flight for interception 2x
2. Aerobatics up to 9 Gz

FIRSTBEAT BODYGUARD2
GRIPEN fighter pilot’s working day – training flight sortie
FIRSTBEAT BODYGUARD2
GRIPEN fighter pilot’s working day – preparation day with gym

Conditioning effect

Strongest stress response

No recovery

stress response / calorie expenditure
Lifestyle assessment (own registration)

PULSE TREND and HRV in Low pressure Chamber (5 500 m VR flight)

Strongest stress response
No recovery

LPC run from 11:22, simulated ER from 11:37
(18 000 feet, hypoxia) descent to 3000 m, oxygen from 11:40
PULSE TREND and HRV in Low pressure Chamber (5 500 m VR flight)

Lifestyle assessment (own registration)

Intensive recovery ??

11:15

Strongest stress response

Body resources

Decline in body resources
ANS IMBALANCE - LOWEST VALUES – LARGER BURDEN

HR / HRV average during LPC flight

- **HR avg (bpm)**
- **HRV (RMSSD) avg (msec)**

**Oxygenation**
- **100% oxygen**

**Hypocapnia**
- **Hypoxia hangover?**
WHO WE REALLY NEED?

ROLAND GARIROS

„GAMER”

„MAVERICK”
CONCLUSIONS

1. continuous exhaustive military training flight missions or paratrooper’s jump sorties - *destabilized vegetative tone* with increased arousal and finally can lead to psychosomatic effects of fatigue or even burnout.

2. lifestyle assessment of pilot / experienced paratrooper - compare the *real burden caused by military mission* / (civil airline flights?) and regular military physical activity and the possible recovery after sorties. Individual reactions!

3. Combined effects of hypoxia and Virtual Reality flight can be studied in *ground-based simulation settings in barochamber* or the mental effort related to combined aeromedical psychometric test batteries can be monitorized as well.

4. AI (machine) vs MAN – who has the final decision? Real time monitoring and BIG DATA: HRV, + NIRS, + EEG