

# Military Pilot's Emotional Stress Analysing

Presentation to

HFM-334 SYMPOSIUM

on

APPLYING NEUROSCIENCE TO PERFORMANCE:  
FROM REHABILITATION TO HUMAN COGNITIVE  
AUGMENTATION

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# Overview

- **Introduction**
- **Why?**
- **Area?**
- **How?**
- **Results**
- **Lessons Learned**
- **Future Work**
- **Know - How**
- **Questions**

# Introduction

## HISTORY:

- Institute was established by decree No.25 of Defence Ministry in May 1922 year and titled „Aeronautics Studio Institute“.



- 1954 – split between Civilian part (VZLÚ) and Military (VZS 031)
- 2012 – VTÚ, s.e.
  - One of the fields where the Institute is interested in is Human Factors in Military Aviation (HFMA)



# Application of HF in Military Aviation

## ■ Why:

- Possibility of the pilots psychological stress detection;
- Methodology for the stress evaluation;
- Possibility of increasing the pilot's tolerance to psychological stress;
- Training improvement;
- Safety reason.

## ➤ Area:

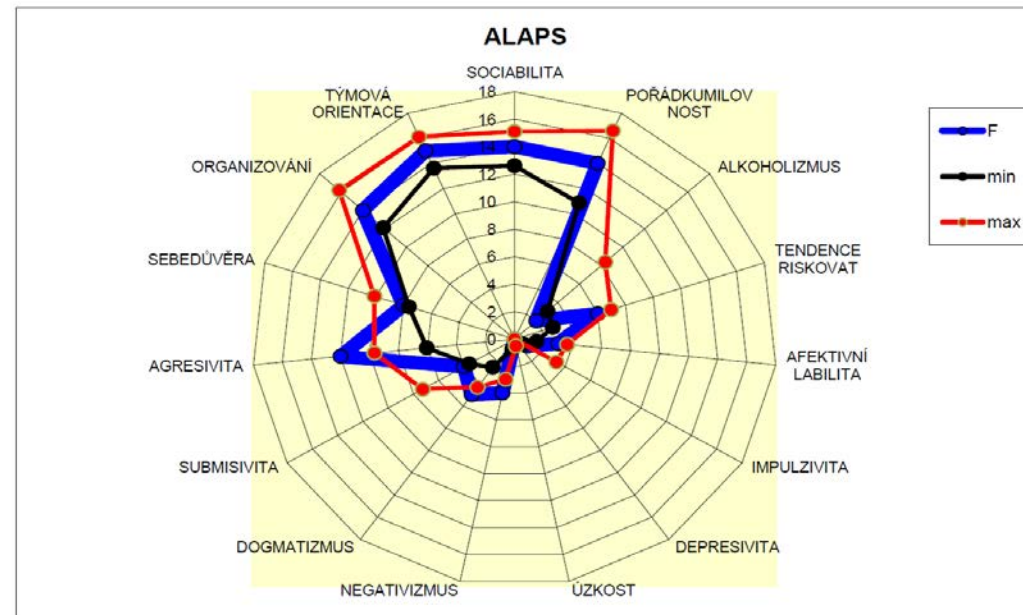
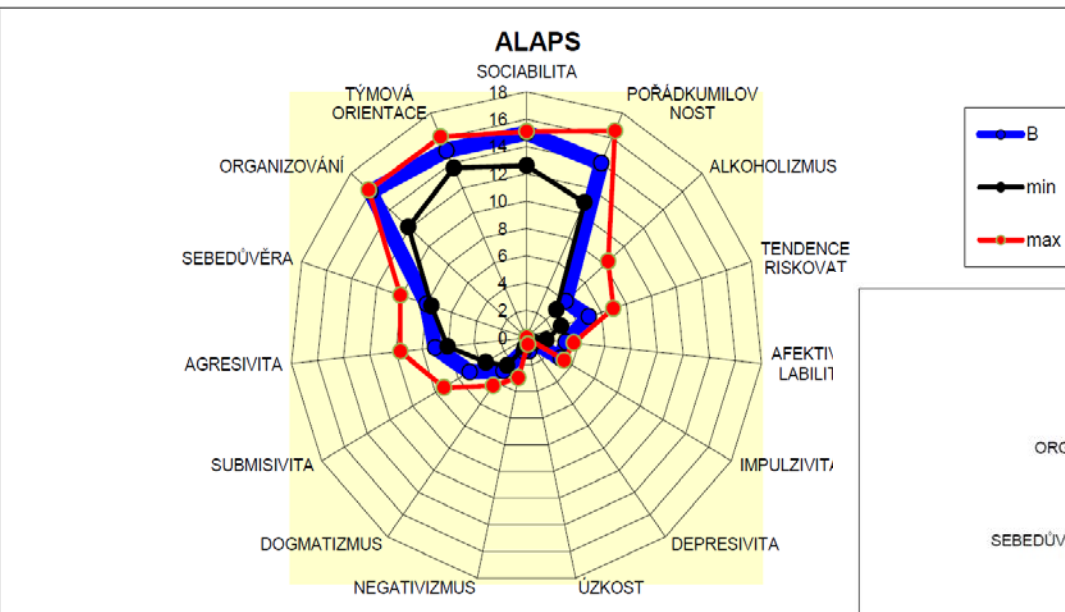
- ✓ Combat Jet Pilots (Combat ready level) - supersonic and subsonic.

## Fields of Interest HFMA

- **Period 1:** The impact of emotional stress on tactical decision of the Air Force combat supersonic fighter pilots (2013-2015).
- **Period 2:** The tactical training effectivity increasing for the Air Force combat supersonic fighter pilots in the tactical simulator due to their resistance to the high information load (2016-2018).
- **Period 3:** The training effectivity increasing for Air Force subsonic fighter pilots in the simulator from the unexpected situation point of view (2018-2020).

# Conditions

## Testing of Combat Jet Pilots Homogeneity - ALAPS (Personality Inventory)



# Used Methodology

## Objective measurements

- Heart Rate (HR) – relative HR (coefHR);
- Eye Activity (ETM);
- Voice;
- EEG;
- Temperature;
- Skin Resistance;
- Breath Frequency;
- Bloody Analysis

## Subjective (personnel) Filling – psychological questionnaire

## Subjective Evaluations (Instructor/Commander) - Evaluation Grade Sheet



# Used Methodology

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- ~~➤ EEG;~~
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## Subjective Evaluations (Instructor/Commander) - Evaluation Grade Sheet

# Evaluation Methods

## HR

### List of the ETM parameters used from 2. period for analyses

- Saccade Average Speed [px/ms];
- Blink Duration [ms];
- Blinks Per second;
- Fixation Duration [ms];
- Fixations Per second;
- Average Pupil Area [px].

## Voice – for 3. period

# Currently Used Technology

## Eye Tracking Measurement

### KIT – PupilLabs and SMI

- Lightweight, non-impeding Eye Tracking glasses
- Collects objective eye data that are analysed by a computer program

## Heart Rate – COTS (Polar) + sensor

## Voice recorder – from simulators

# Experimental Environment

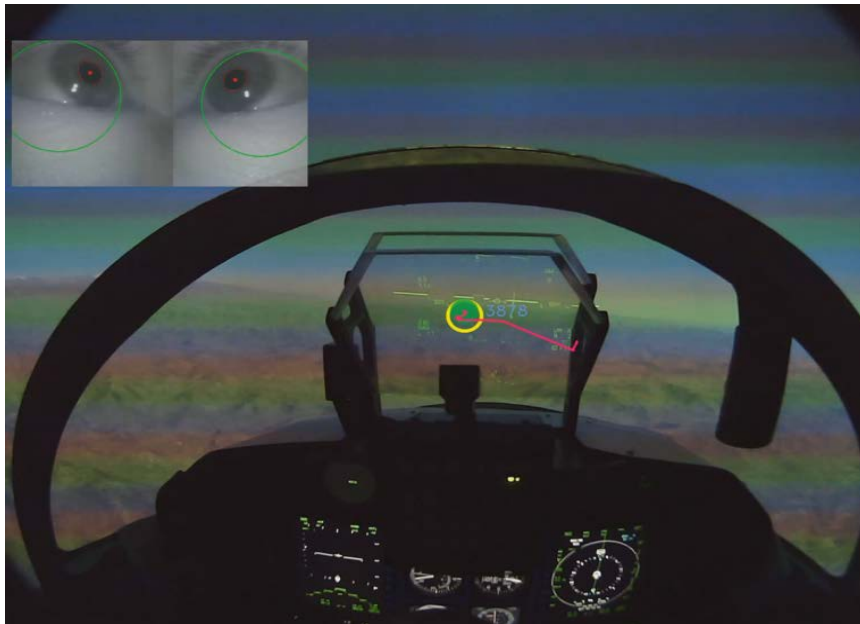
## Simulators:

- Tactical Simulator for supersonic a/c + subsonic a/c (1. + 2.P)
- FMS of subsonic a/c (3.P)
- PC Simulator - Demo

# Tactical Experimental Environment



# Experimental Environment of FMS



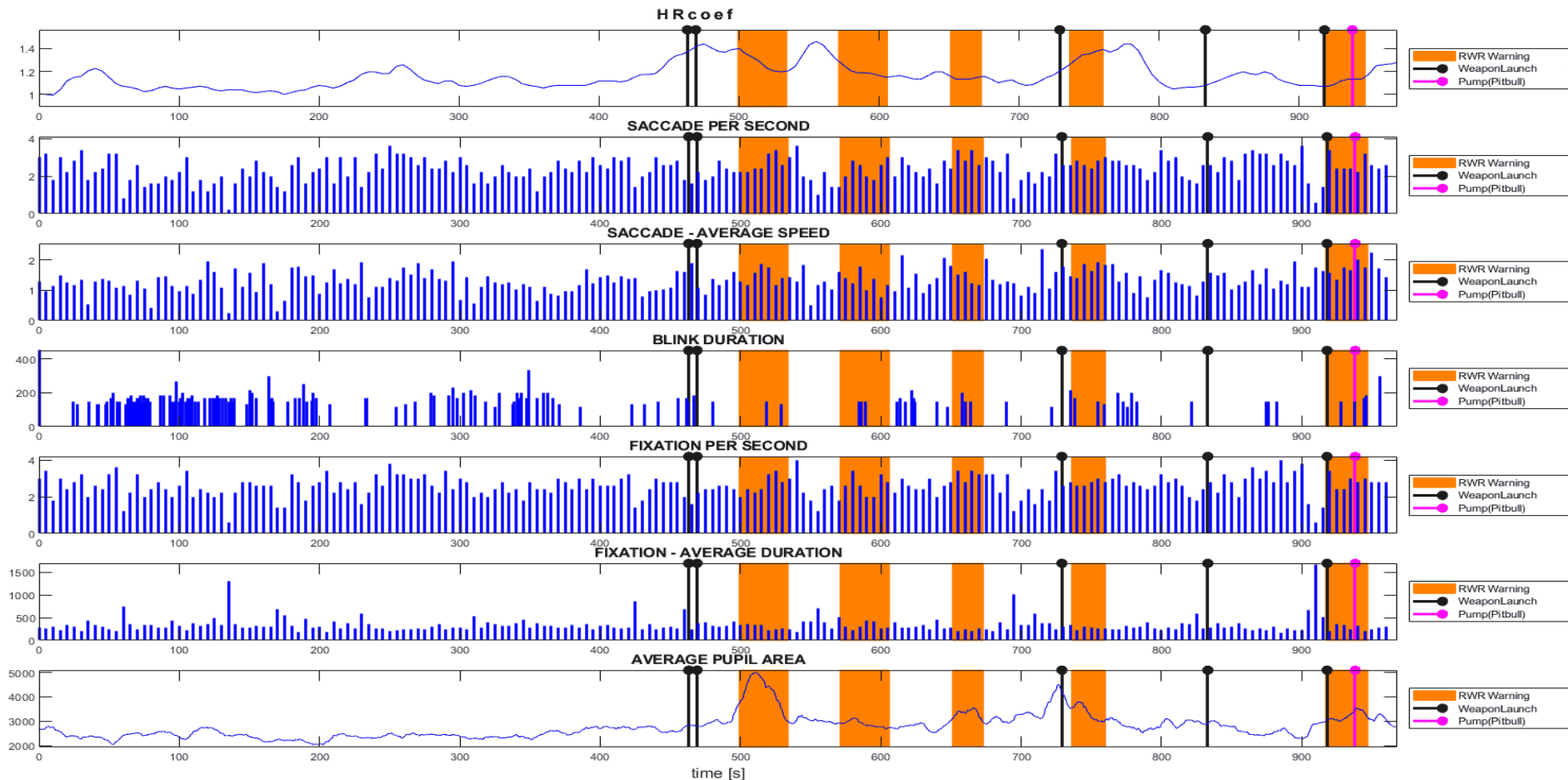
## Results of 1.Period

The obtained results shows distribution of relative Heart Rate in the following three levels:

- The relative Heart Rate was **lower or equal the value 1,3** - in these cases the pilot was not concentrated (in most cases he was shot down).
- The relative Heart Rate was in the **range between values 1,3 and 1,5** - in these cases the pilot was in right tension, fully concentrated.
- The relative Heart Rate was **higher than value 1,5** - in these cases the pilot was in the appreciable emotional stress. In the most cases the pilots made mistakes (e.g. correct decision but noncorrectly provided or impetuous reaction). The increased level of the stress was seen also in the nervous communication.

# Results of 2.Period

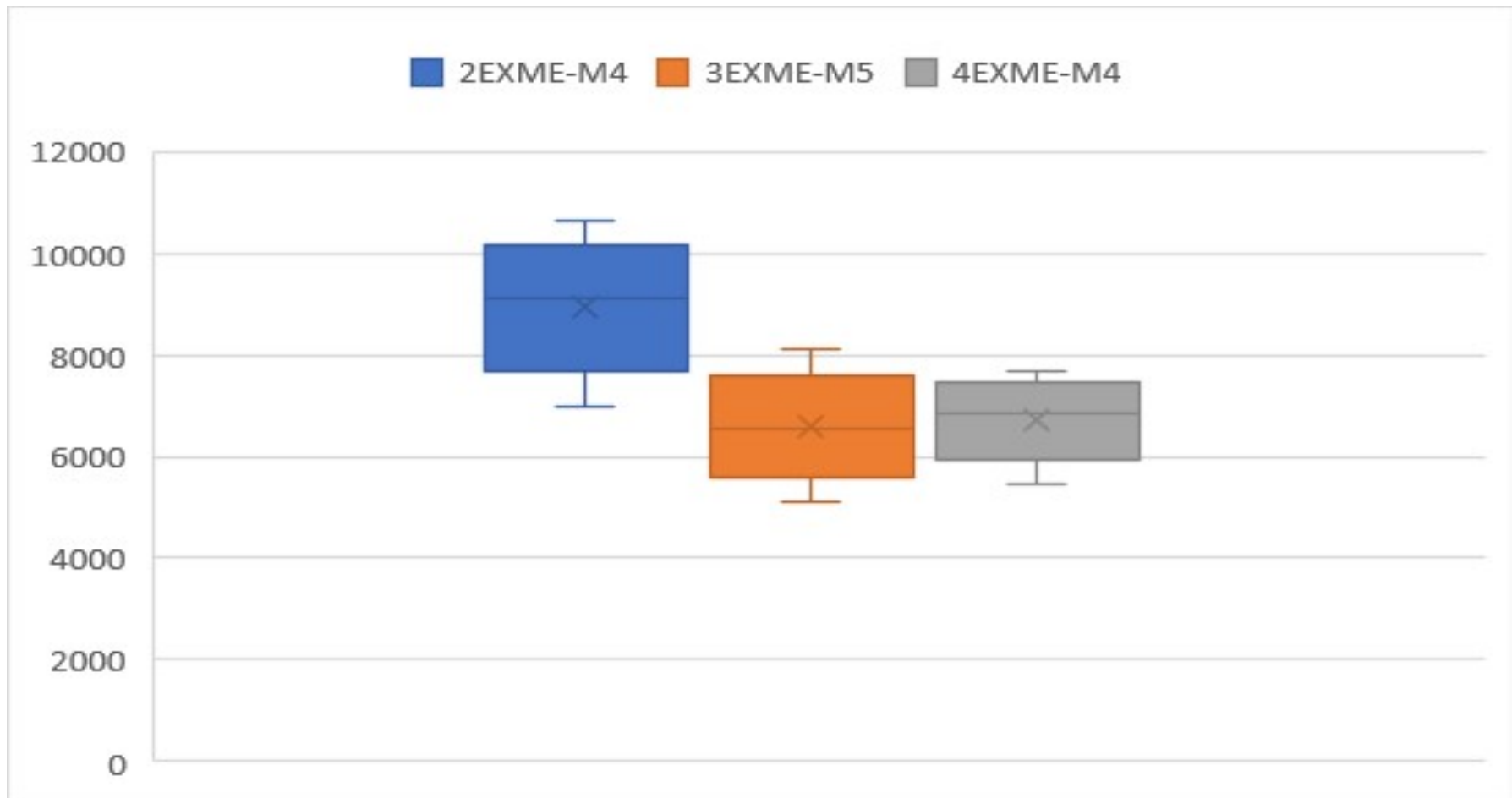
The example of the relative Heart Rate and individual parameters of the eye activity in the timeline during the mission.





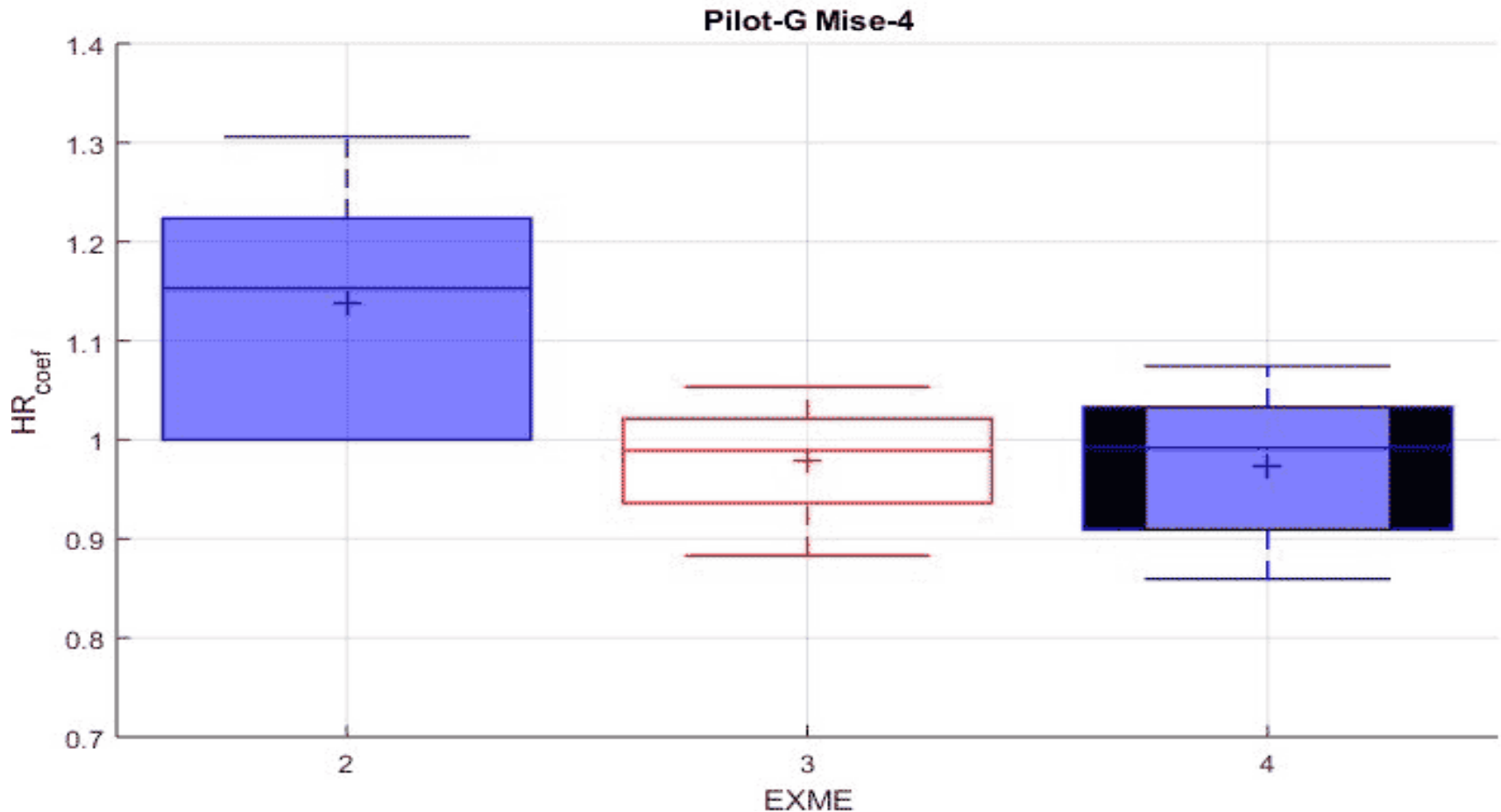
# Results of 2. Period

## Trend of Average Pupil Area



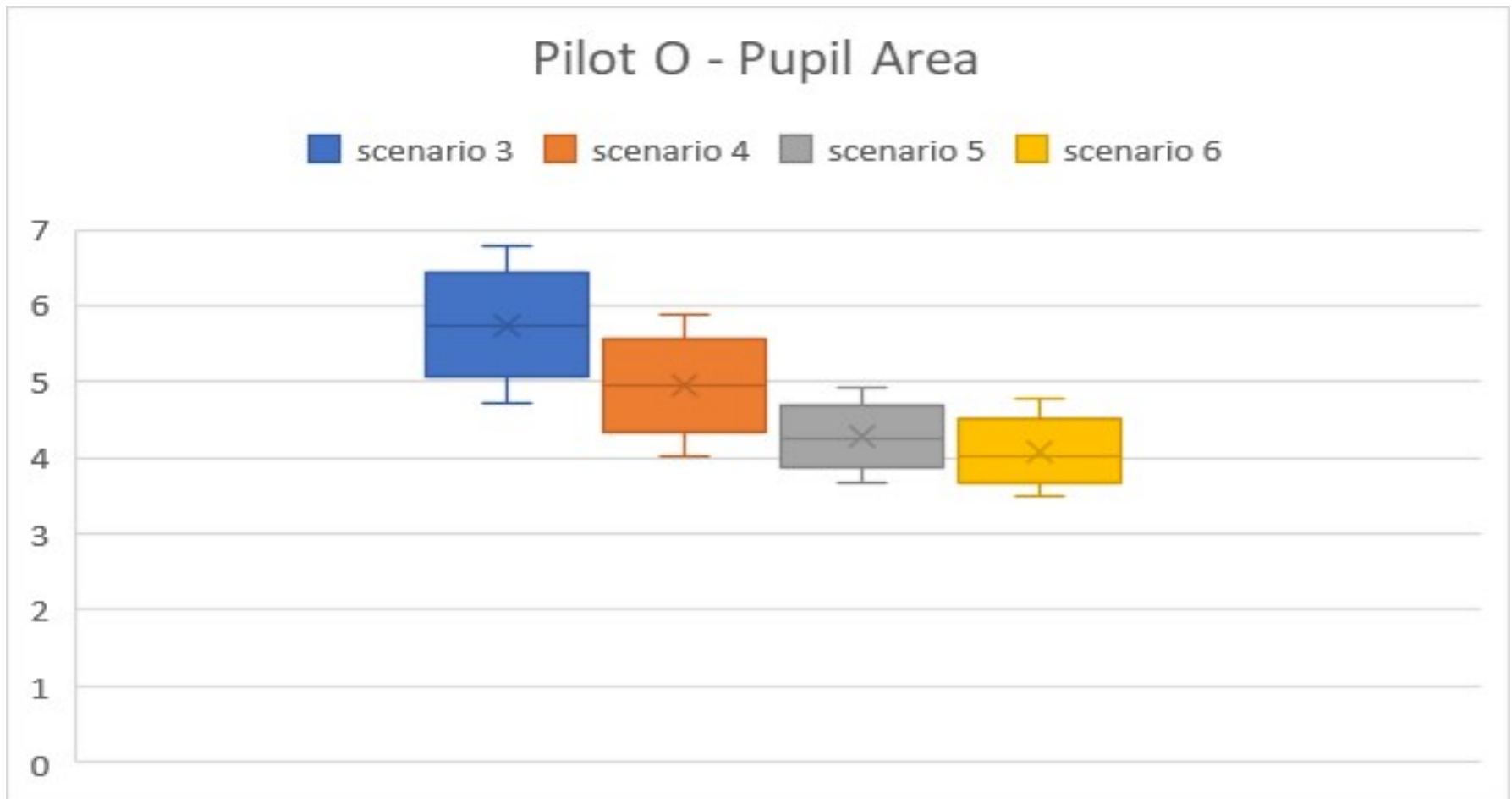
# Results of 2. Period

## Trend of Hear Rate coefficient



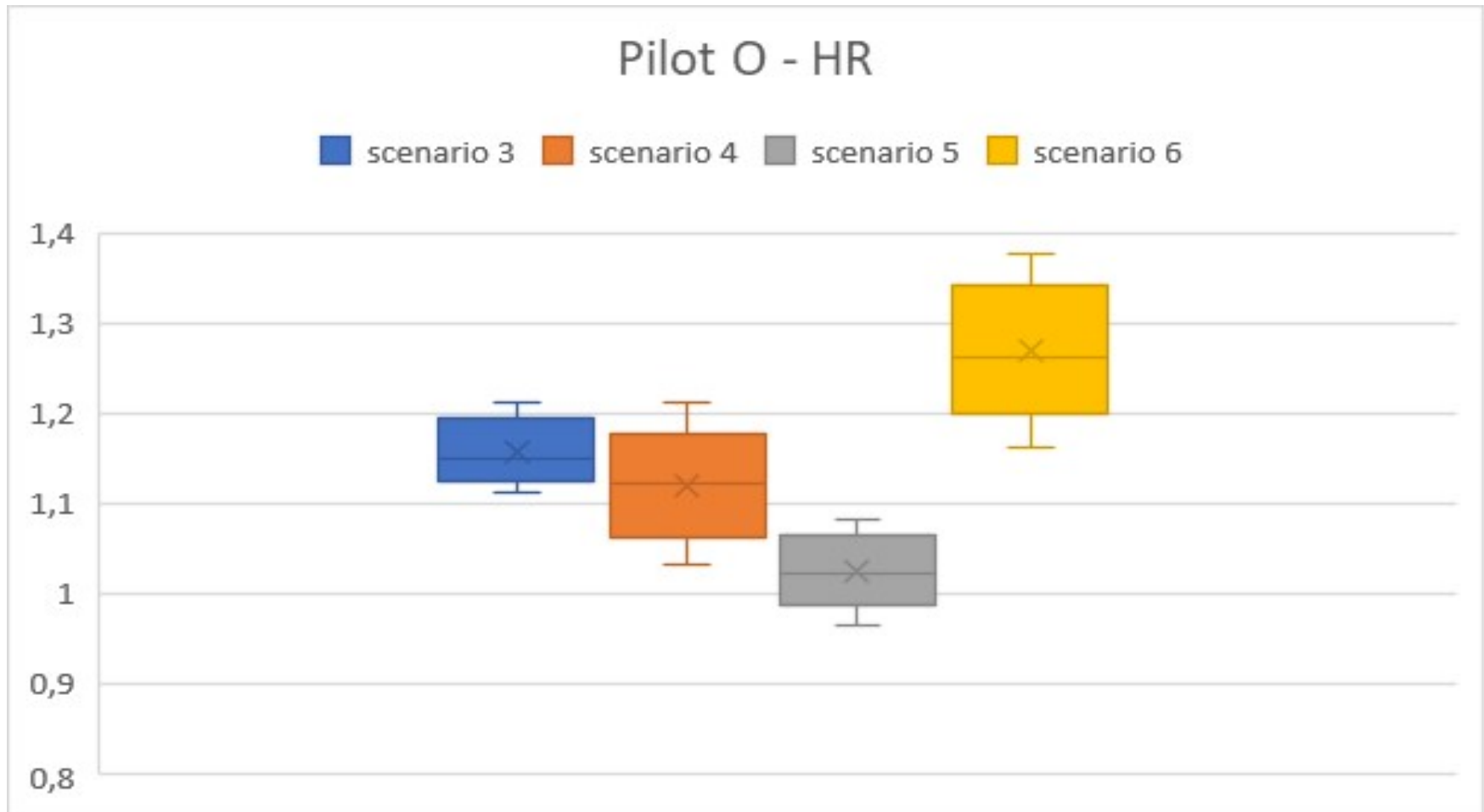
# Results of 3. Period

## Trend of Average Pupil Area



# Results of 3. Period

## Trend of Hear Rate coefficient



## Lesson Learned

- **Massive Explanation of Goals** before Testing – pilots are very sensitive group
- **Motivation** of Tested Pilots
- **Testing Environment** – simulators (safety reason)
- **Very high provision** of results from measurements - **to support commanders for evaluation**
- **Eye tracking OK** in simulators, but failed in very dark conditions
- **Impact of our project results** for new activity

## Future Work

- **Application of the Neural Networks for the Voice Analyses**

## Know - How

- The results show that the relative Heart Rate and the Average Pupil Area are the suitable for emotional stress analysing. The relative Heart Rate seems to be as more sensitive for emotional stress analysing.
- Tested pilot's are highly homogenous group from personality inventory point of view.
- High information load has the negative impact to pilots tactical decision.
- For tested pilots have been find values for detection of:
  - Low level of concentration;
  - Good tension;
  - Stress.

# Thank You for Your Attention

- Any Questions ?
- Any Remarks?

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