Dedicated to innovation in aerospace

Eye Tracking and Human Factors research at NLR

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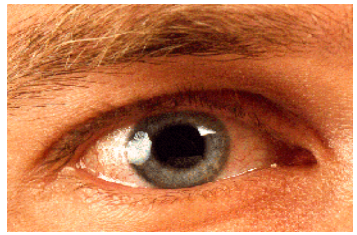
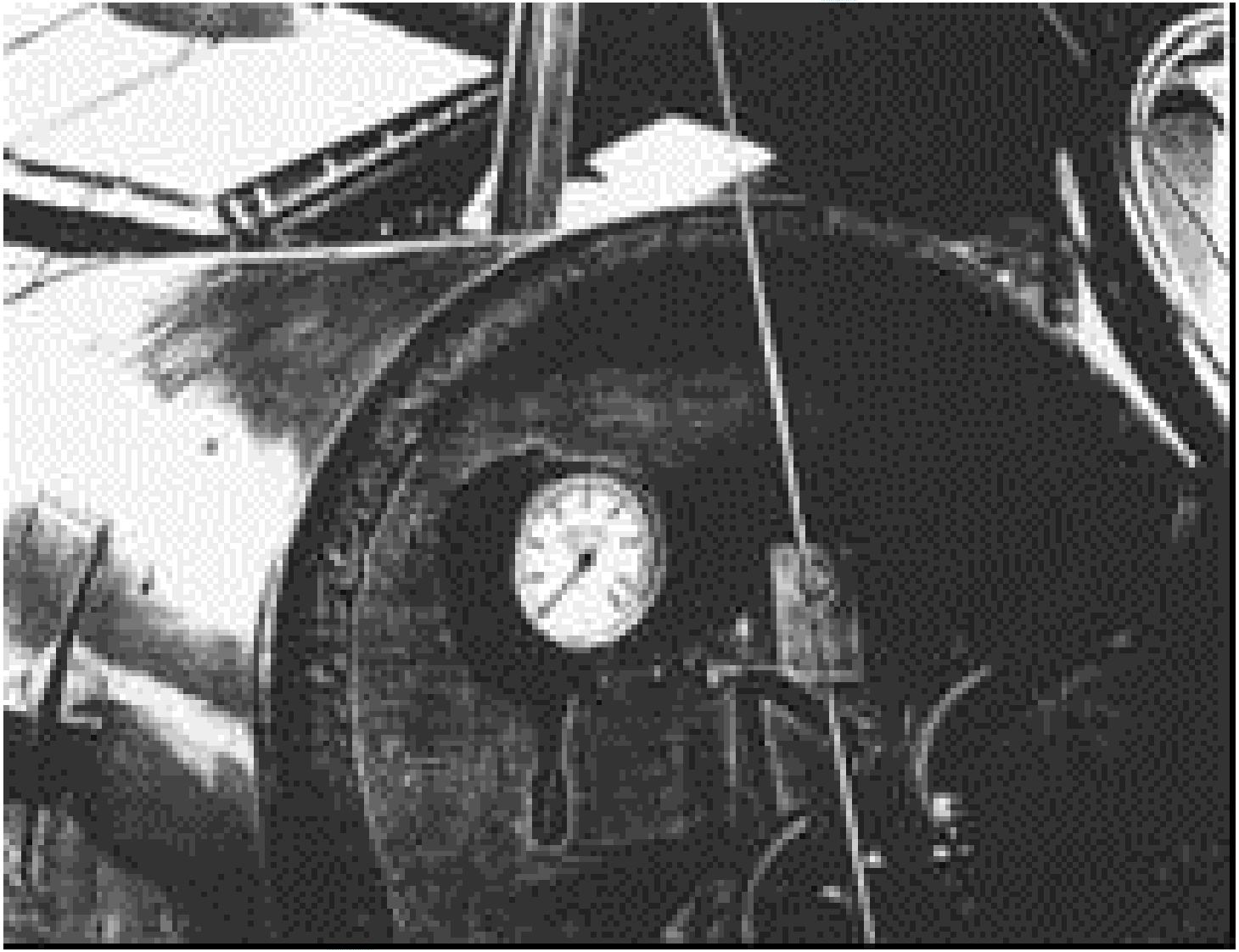


Blackburn B12 Monoplane with Single Engine Indicator (1912)



The modern flight deck

Airbus 350

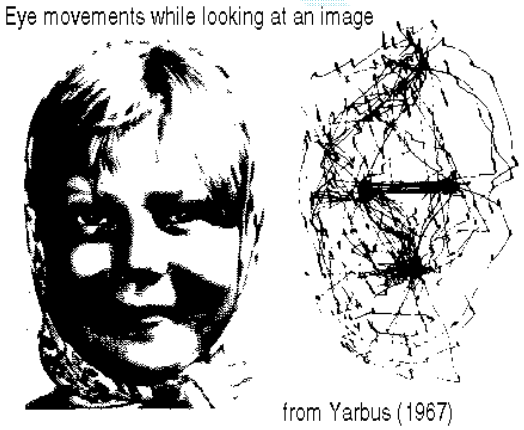
Boeing 787

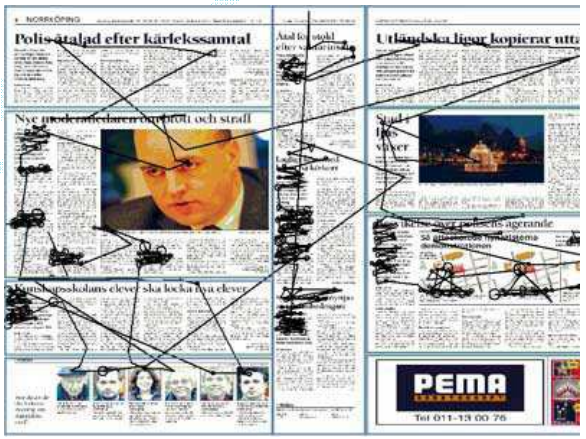
During this presentation ...

- **What is eye tracking?**
  - techniques and facts
  - combining eye tracking data with other data sources
- **At the NLR**
- **Why eye tracking?**
- **Experiences in different environments**
  - Aircraft
  - Trains
  - Touring cars

What is eye tracking?

- **Eye tracking is measuring someone's eye scanning patterns and where that person is focusing on**
  - Measurement techniques differ:
    - Intrusiveness
    - Accuracy
    - Environmental demands
    - Price
    - Degrees of freedom for subject
    - Number of variables measured
  - It does not measure what someone notices in the periphery of the visual field

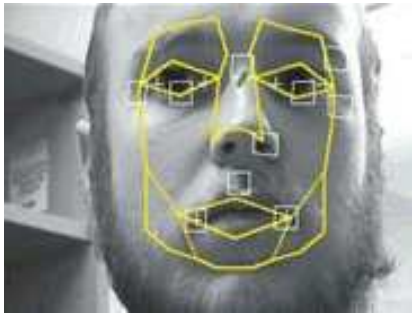




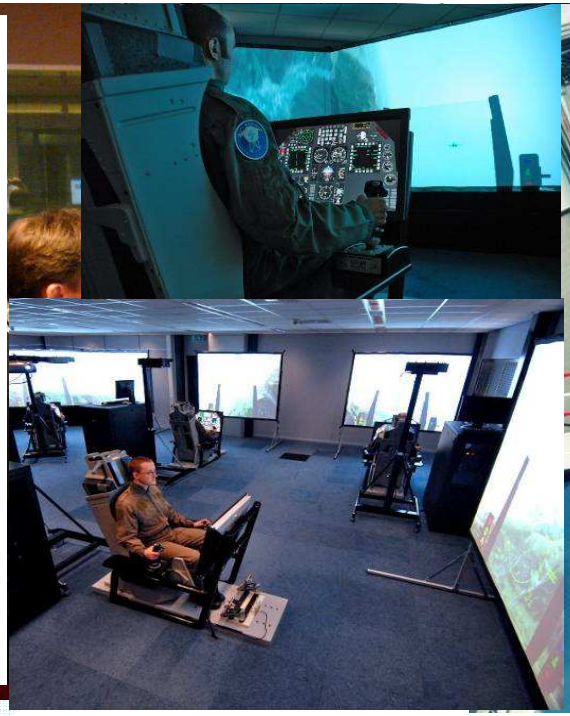
Example: Landing NLR's RFS

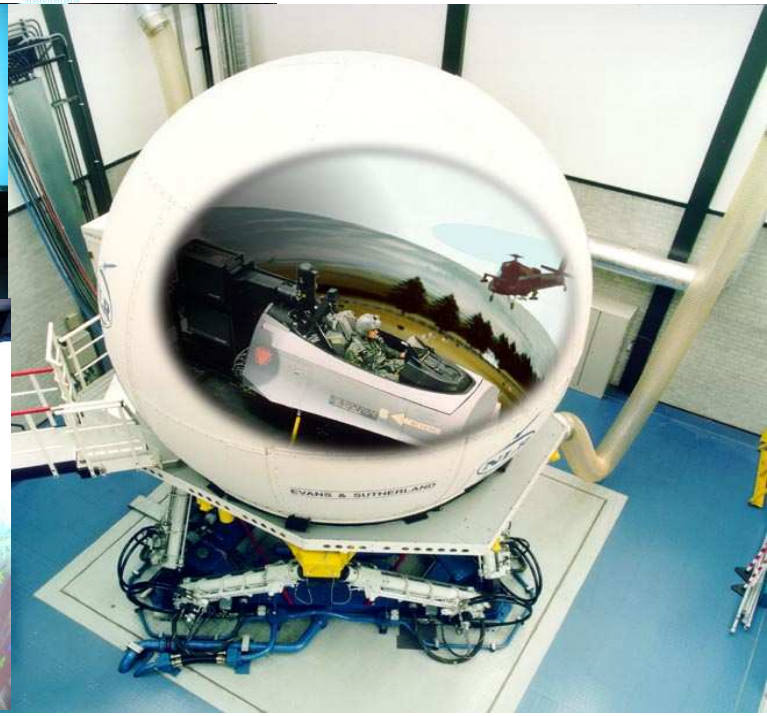
Eye tracking systems at NLR

- **Head mounted (high accuracy and more variables!)**
  - Three GazeTrackers (M&A) and two ASL 501
    - Bright pupil method
    - Pure eye tracking versus Eye Point-of-Gaze (EPoG)
    - Magnetic or optic head tracker
- **Wall mounted (non-intrusive less degrees of freedom to move!)**
  - Two FaceLABs v4 (Seeing Machines)
- **One Ergoneers**
  - Head mounted and easy data processing, no headtracker needed

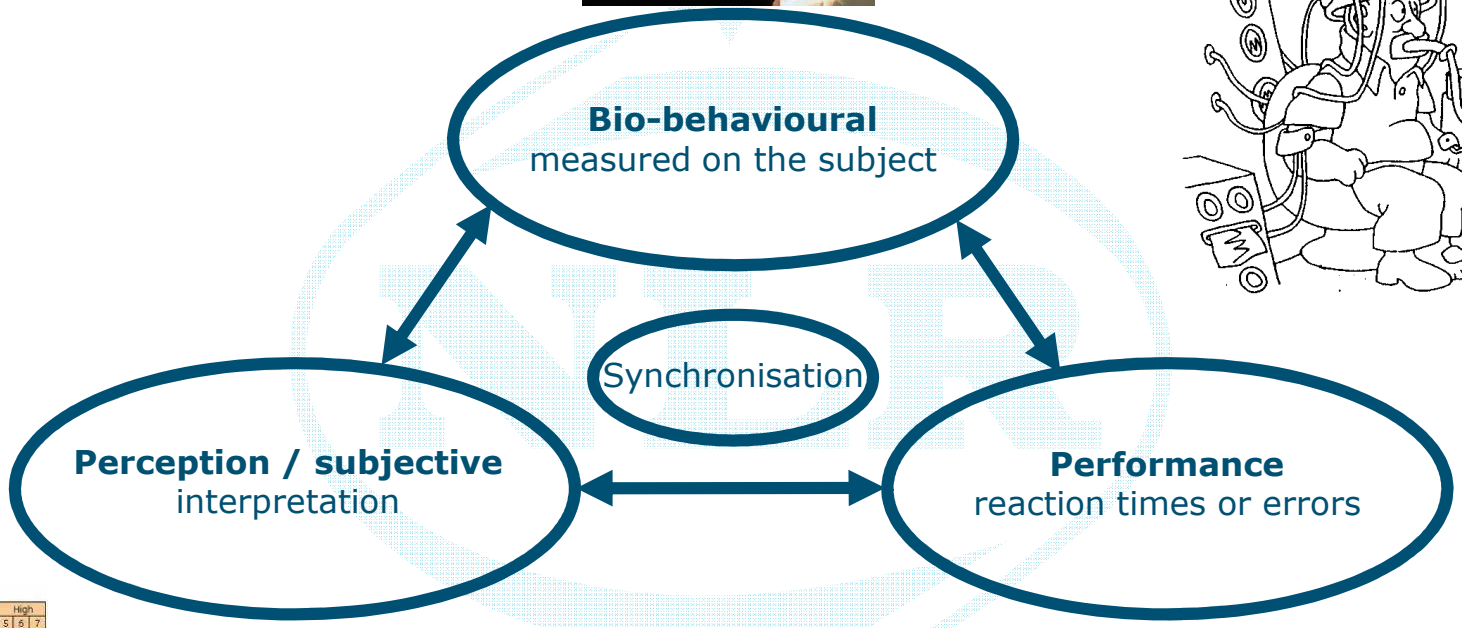


Some of NLR's test platforms

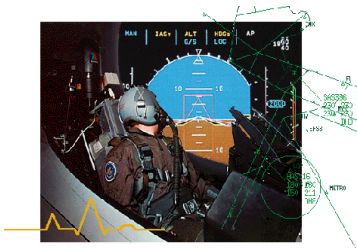




Methodological Triangulation



		Low				High		
		1	2	3	4	5	6	7
Demand	Instability of Situation	○	○	○	○	○	○	○
	Variability of situation	○	○	○	○	○	○	○
	Complexity of Situation	○	○	○	○	○	○	○
Supply	Arousal	○	○	○	○	○	○	○
	Spare Mental Capacity	○	○	○	○	○	○	○
	Concentration	○	○	○	○	○	○	○
	Division of Attention	○	○	○	○	○	○	○
Understanding	Information Quantity	○	○	○	○	○	○	○
	Information Quality	○	○	○	○	○	○	○
	Familiarity	○	○	○	○	○	○	○



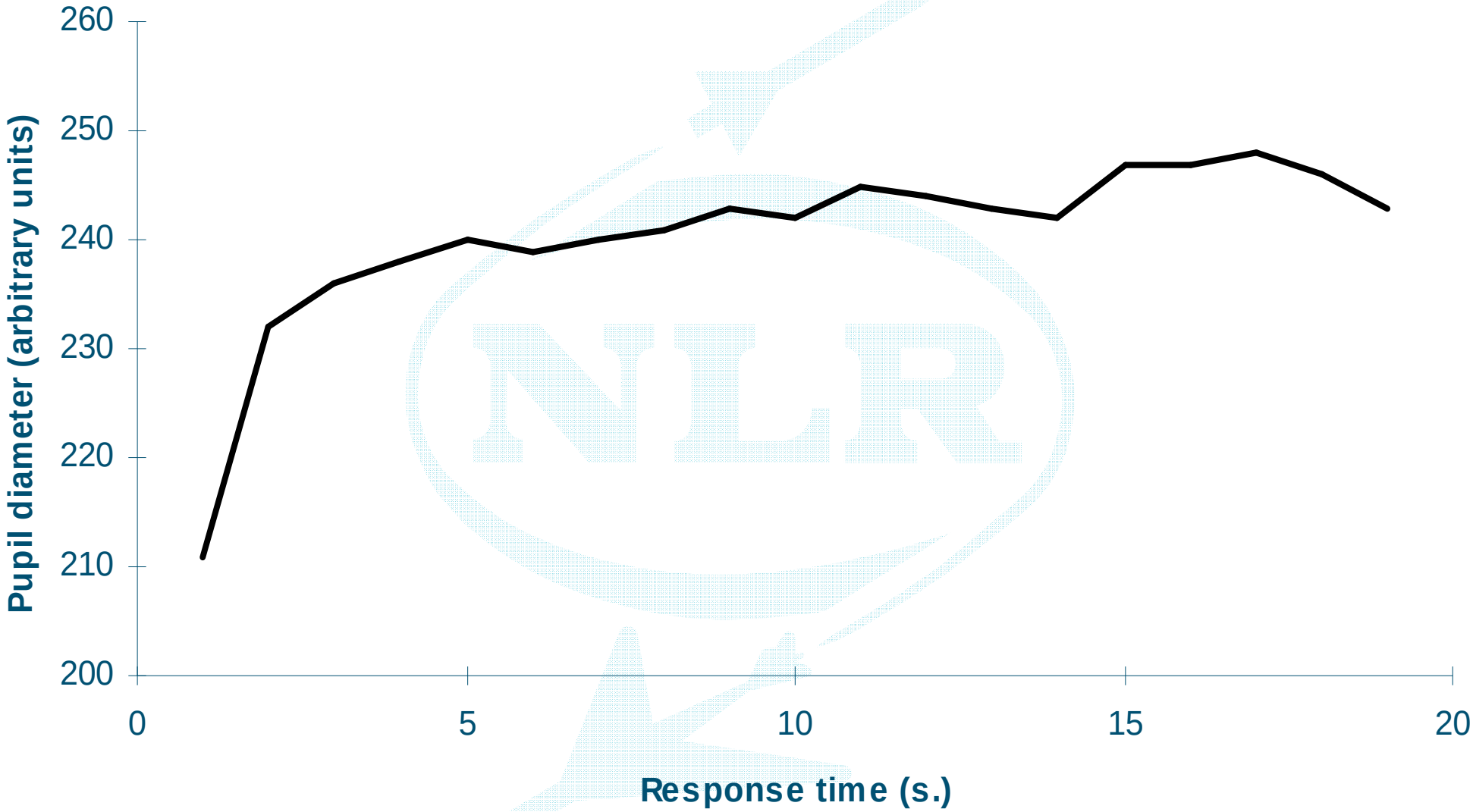
Whole is more than the sum of the individual components

What HF assessment (with eye tracking) provides?

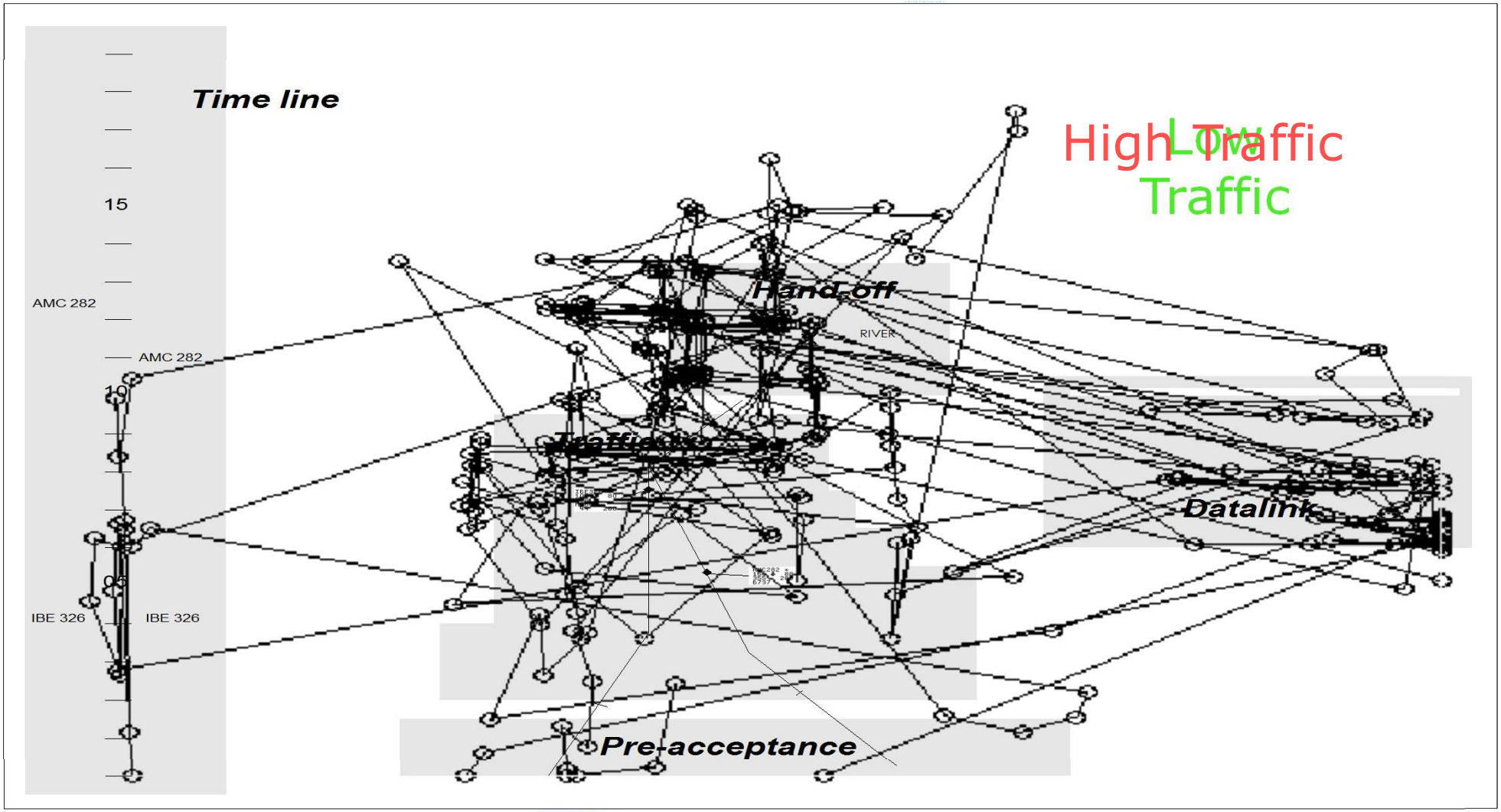
- **Evaluate hypotheses regarding: displays, lay outs, new concepts, procedures or designs for:**
  - Safety
  - Efficiency
  - Comfort
  - Acceptability
  - Usability
- **Contributes to assessment of**
  - (Mental) workload
  - Situation Awareness
  - Operator strategies
  - Error recovery strategies
  - Fatigue
- **Human Factors certification**
- **Training tool**
  - Feed back
  - Real time
- **Input device**
- **Adaptive Automation**

Data processing

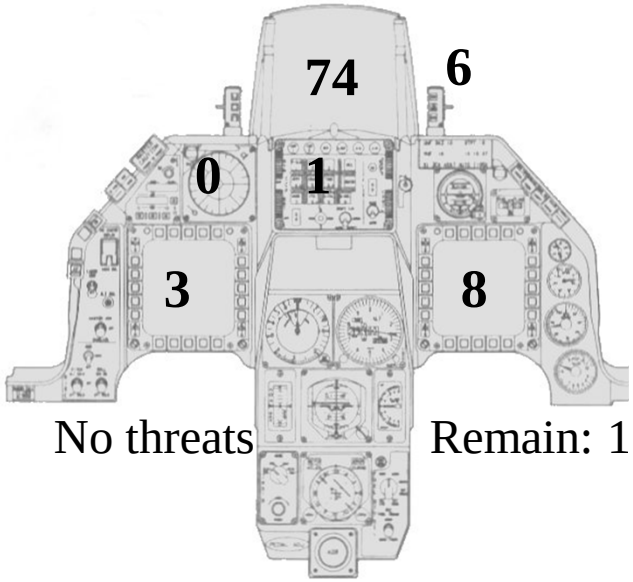
Mental arithmetic (N=1)



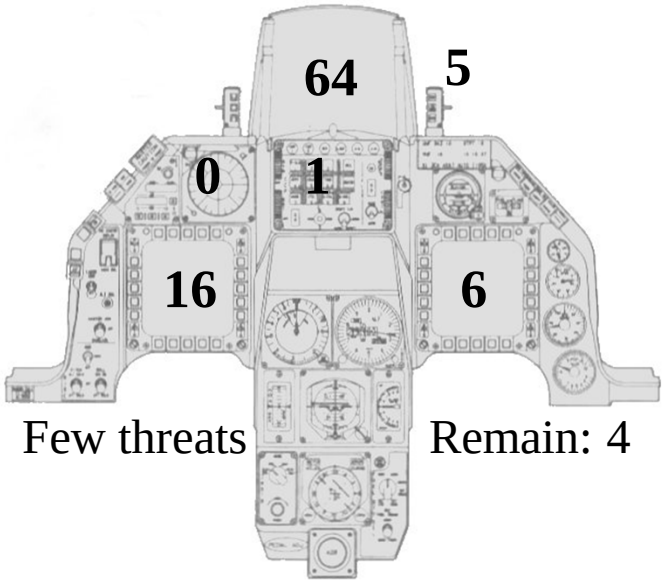
Experiment with increased task loading approach Air Traffic Control with Low and High traffic (N=1)



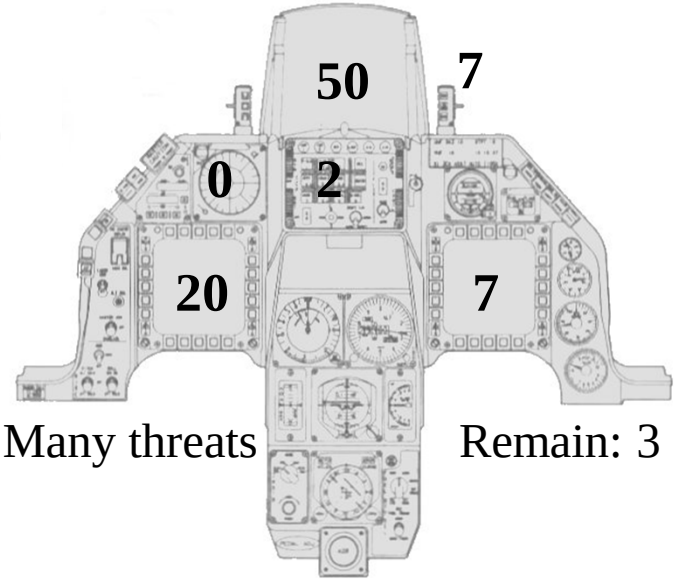
Percentage dwell duration (3 different missions, N=1)



No threats Remain: 1



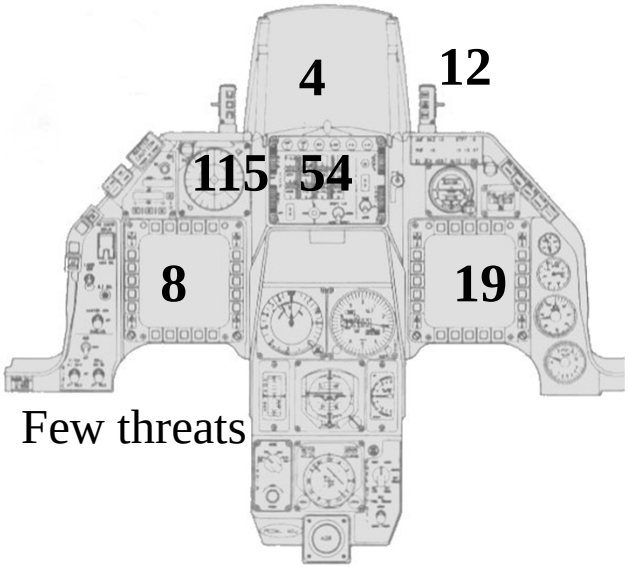
Few threats Remain: 4



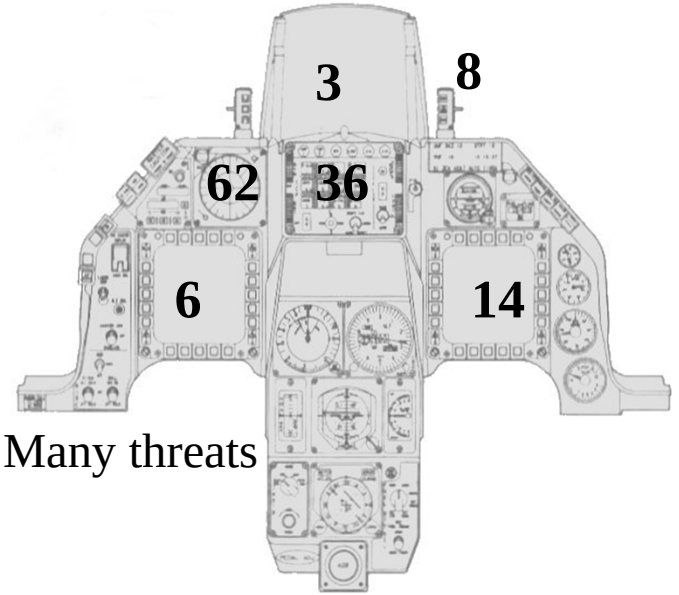
Many threats Remain: 3

Interdwell times (seconds) (3 different missions, N=1)

No threats



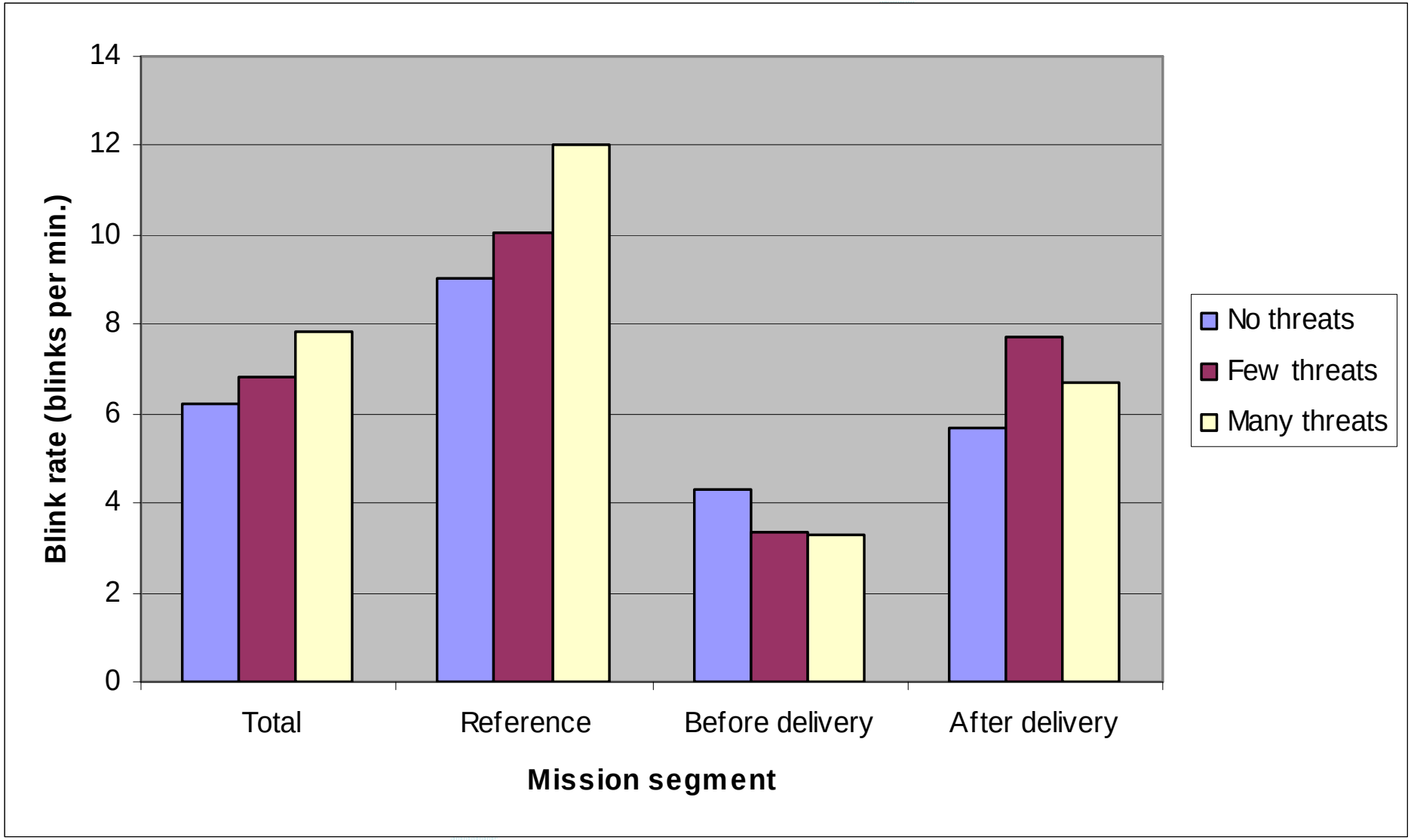
Few threats



Many threats

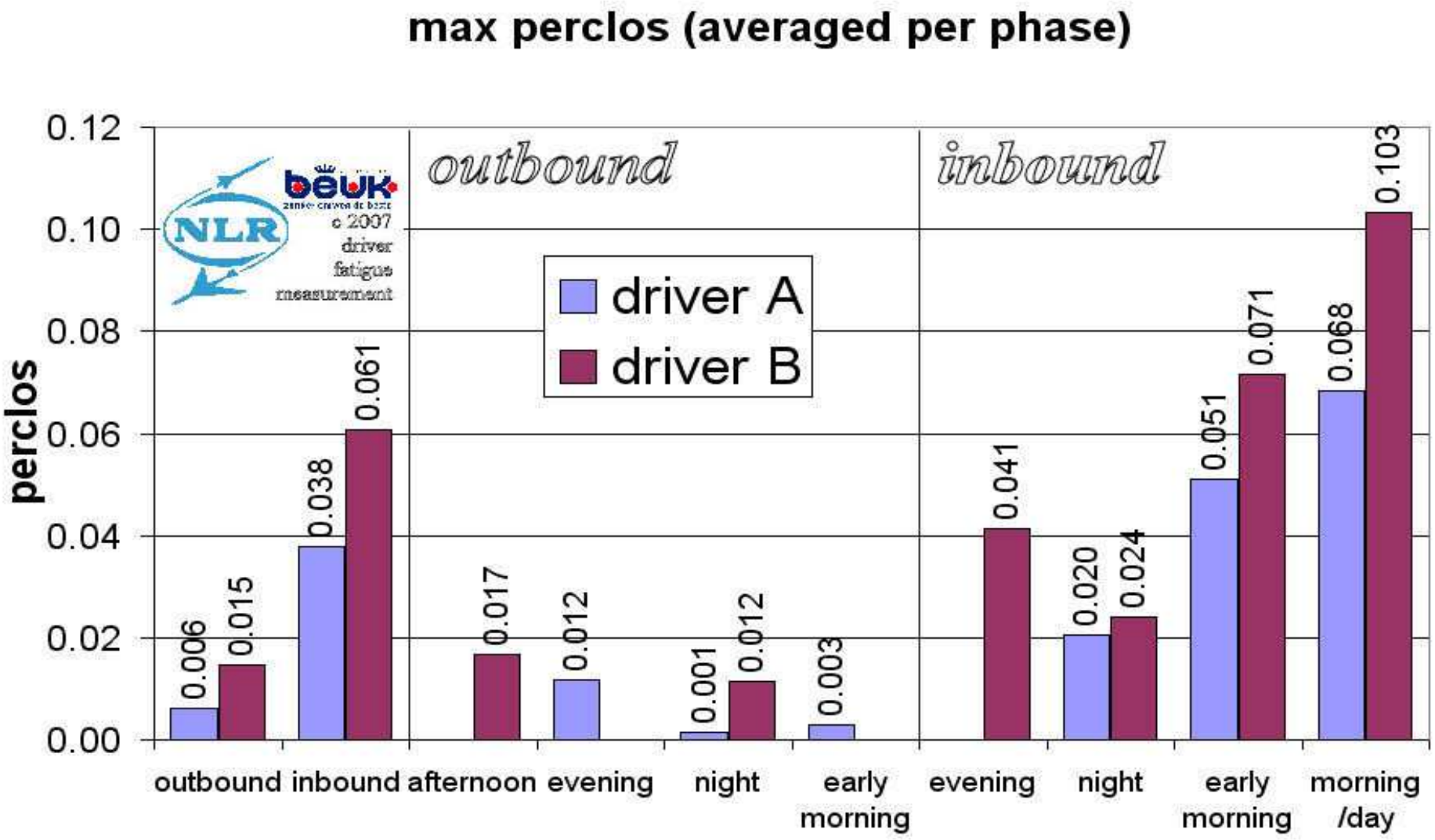
Interdwell time = the average number of seconds that it takes for the pilot to return to the same area-of-interest (AoI) since he looked there for the last time.

Eye Blink Rate (N=1)



Machinisten

Touring car driver fatigue



Thank you for watching and listening!!!

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Questions?

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