Parallel Session

Operational Evidence of Fatigue: Flight Operations

Effects of Fatigue on Threat and Error Management Behavior of Long-Haul Flight Crew

Matthew Thomas, Ph.D.
University of South Australia

15:10 - 15:35

June 17, 2008

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008

Matthew Thomas, Ph.D.
Biography

Dr. Matthew Thomas is a Senior Research Fellow and Program Director of Human Factors at the University of South Australia. His research interests focus on Human Error and Training Systems Design and is currently involved in a range of industry projects across aviation, rail, healthcare and other high-risk domains. He has been developing innovative approaches to simulation-based training and assessment and specializes in the area of Non-Technical Skill development and Error Management. He has taught in the area of Human Factors in Australia, New Zealand and Singapore, and is the President of the Australian Aviation Psychology Association.

Australian Long-Haul Fatigue Study

Fatigue and Threat and Error Management

FAA Aviation Fatigue Management
Partnerships for Solutions June 17-19 2008

UniSA

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Qantas
Civil Aviation Safety Authority
Australian and International Pilots Association
Australian Research Council

Scientific Reference Panel

The Research Team

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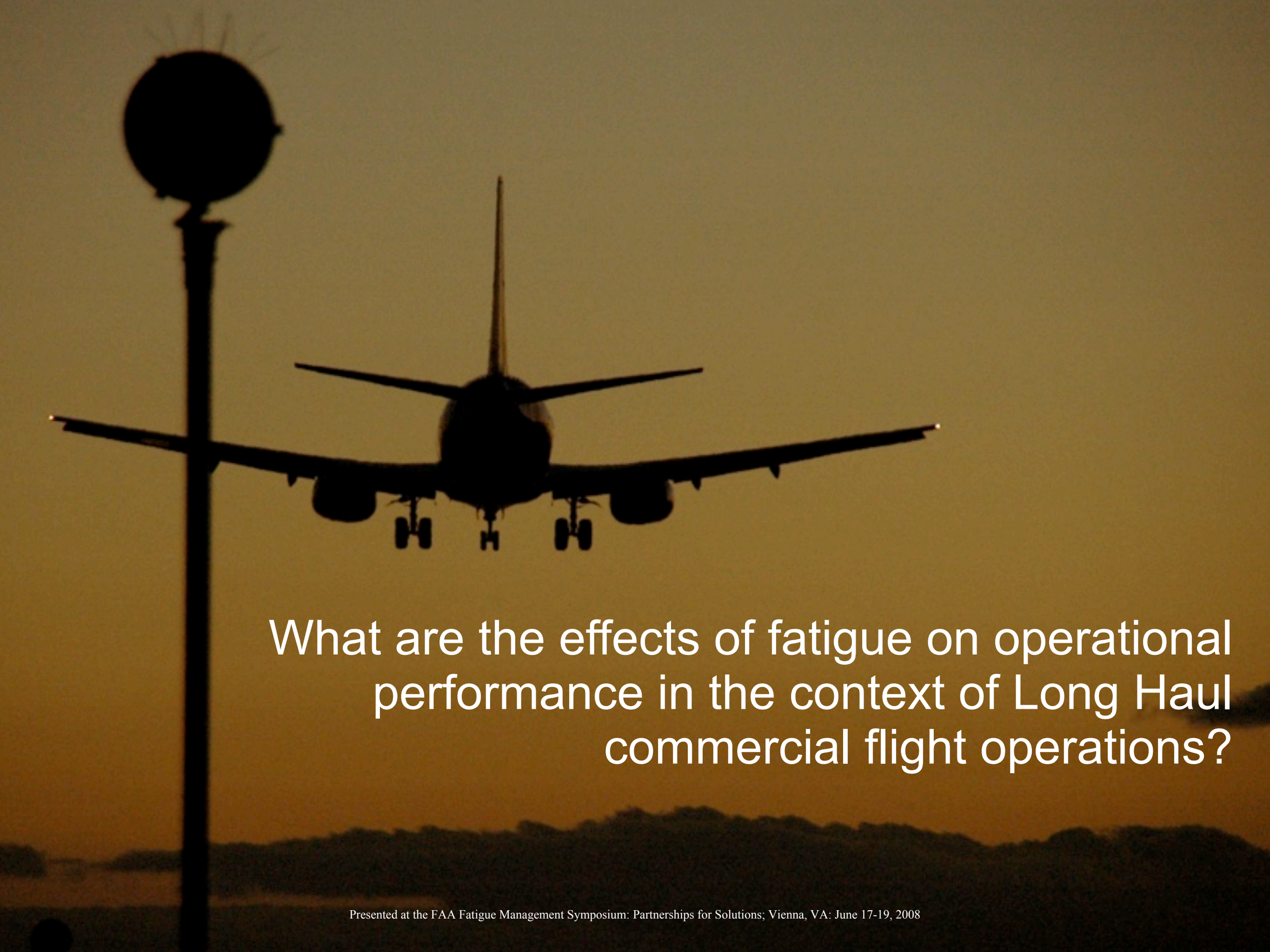

What are the effects of fatigue on operational performance in the context of Long Haul commercial flight operations?

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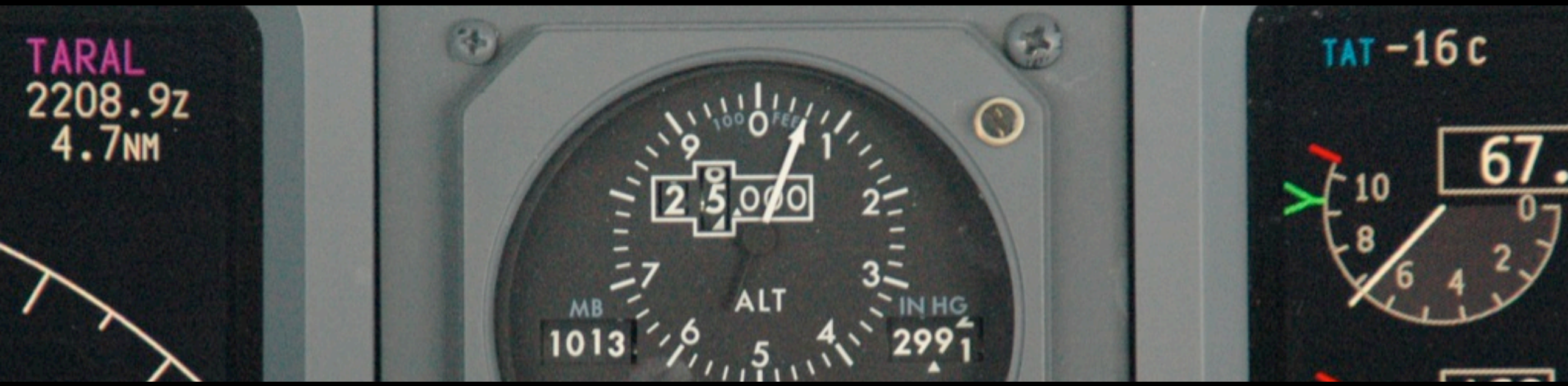
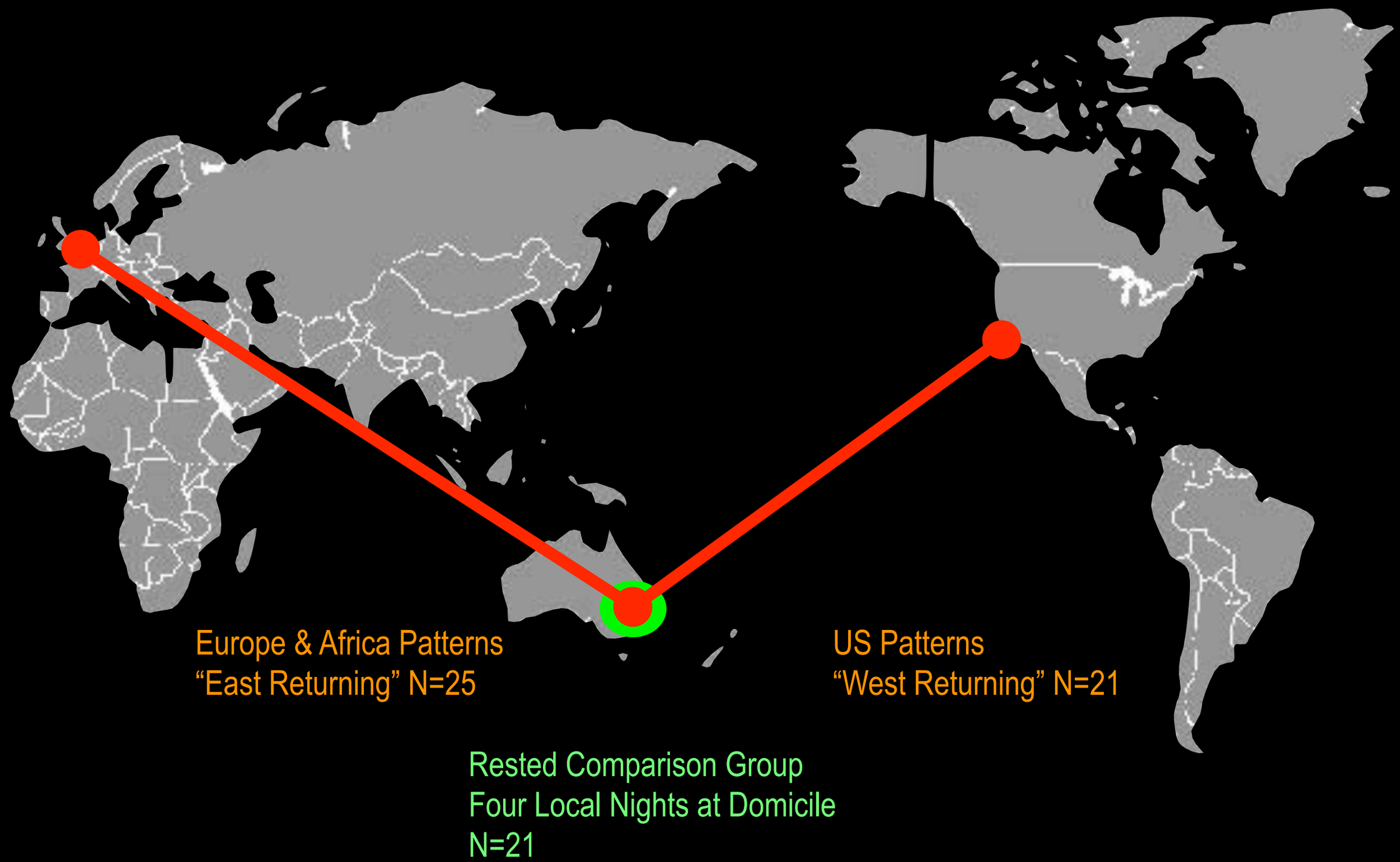
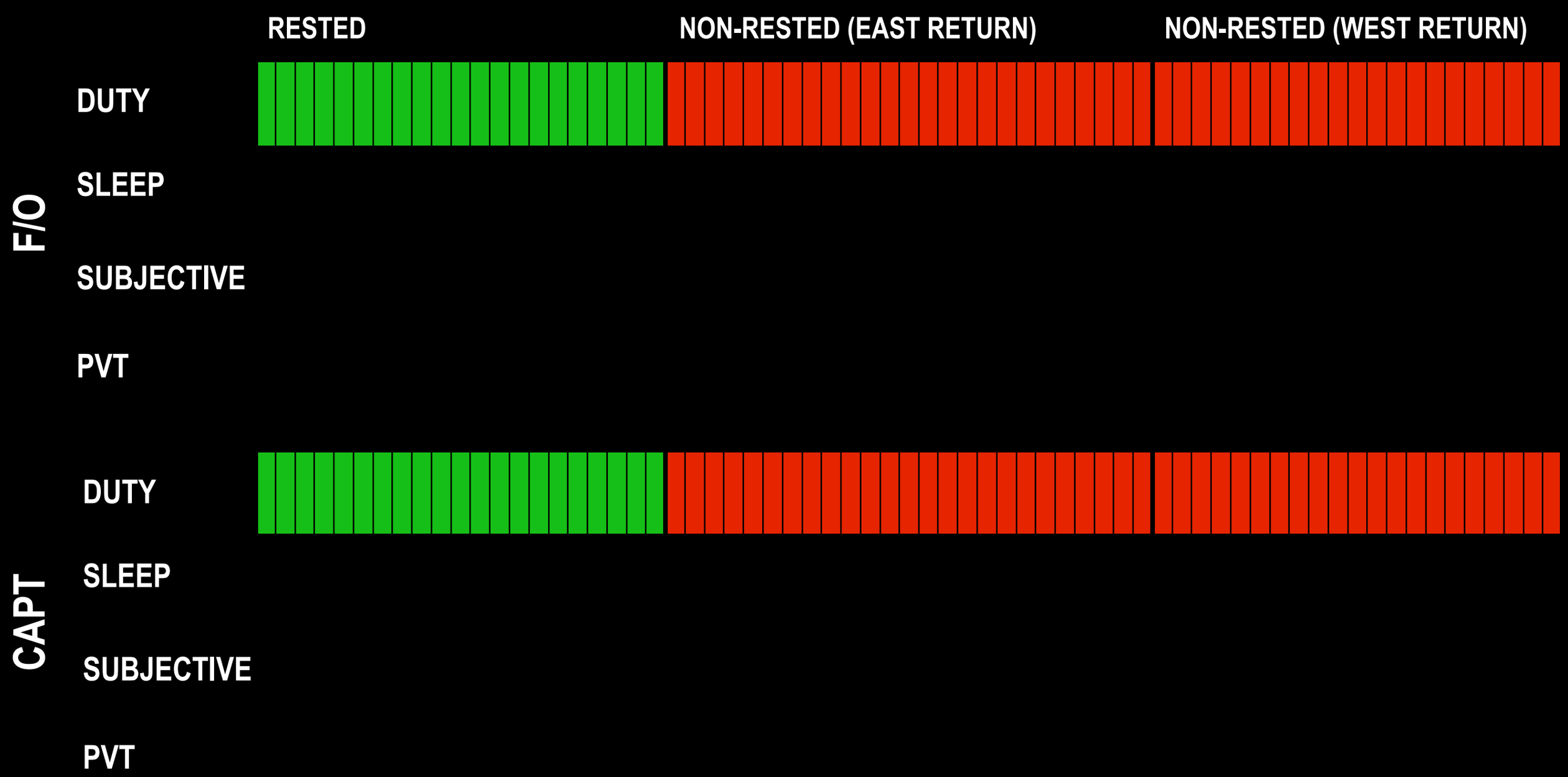
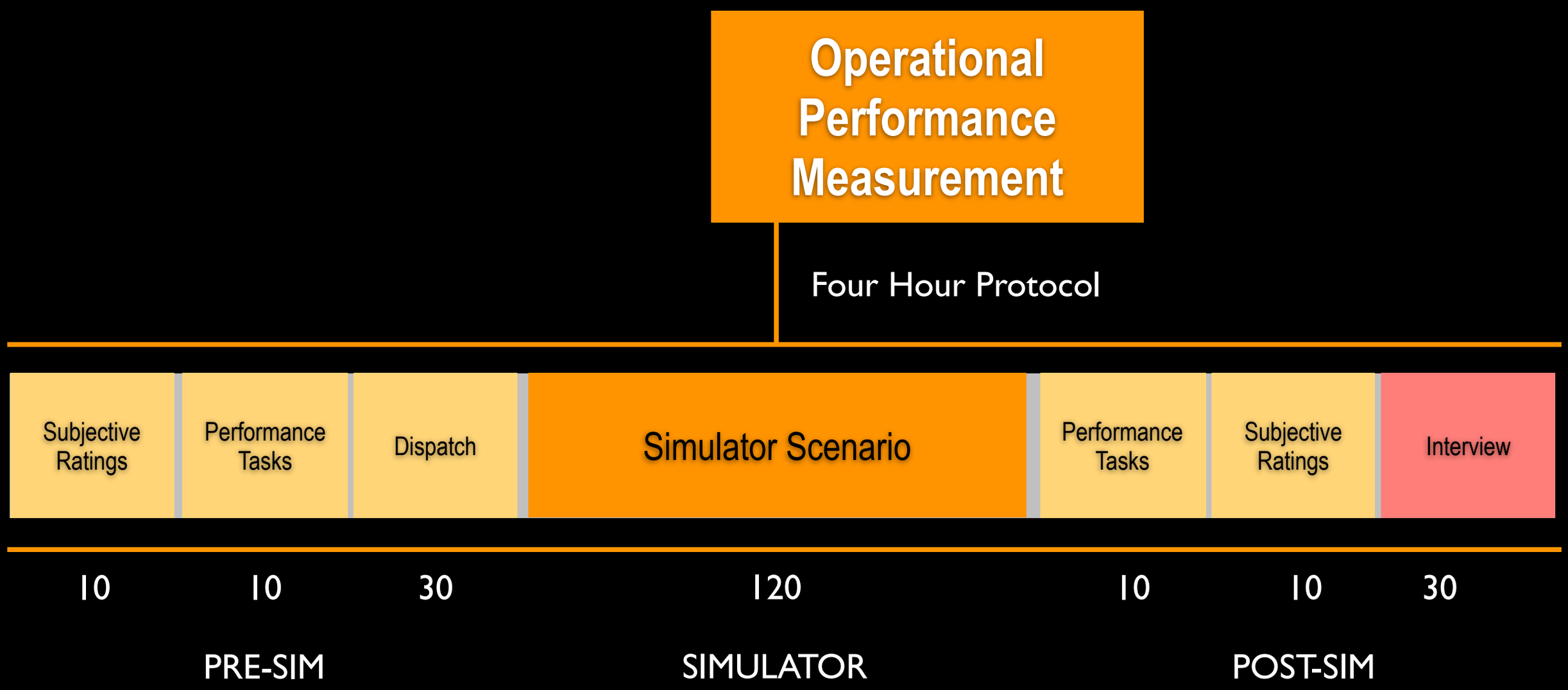
Method



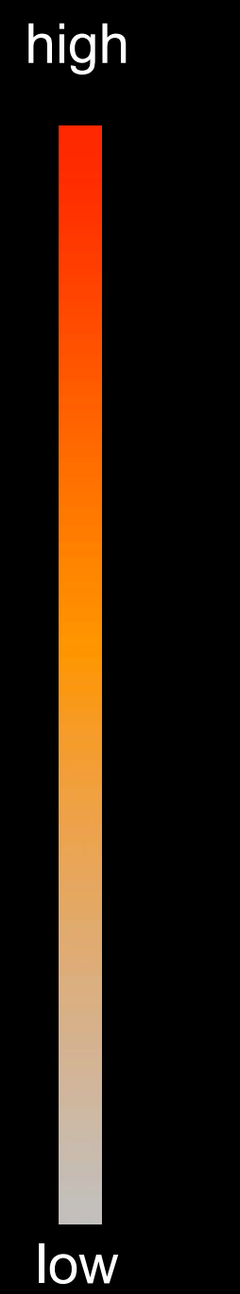

Europe & Africa Patterns
“East Returning” N=25
US Patterns
“West Returning” N=21
Rested Comparison Group
Four Local Nights at Domicile
N=21


RESTED
NON-RESTED (EAST RETURN)
NON-RESTED (WEST RETURN)
F/O
DUTY
SLEEP
SUBJECTIVE
PVT
CAPT
DUTY
SLEEP
SUBJECTIVE
PVT

Experimental Protocol



Scenario Structure



T1 Dispatch with Thrust Reverser "Locked Out"

T2 Change in Loadsheet

T3 Change in Duty RWY

T4 Clearance to Lower Altitude on Departure

T5 Higher Cruise Level & Expedite Climb

CDE Critical Decision Event

T6 High Speed Descent & Track Shortening

T7 ATC QNH Error

T8 Failure to Provide Clearance to Land

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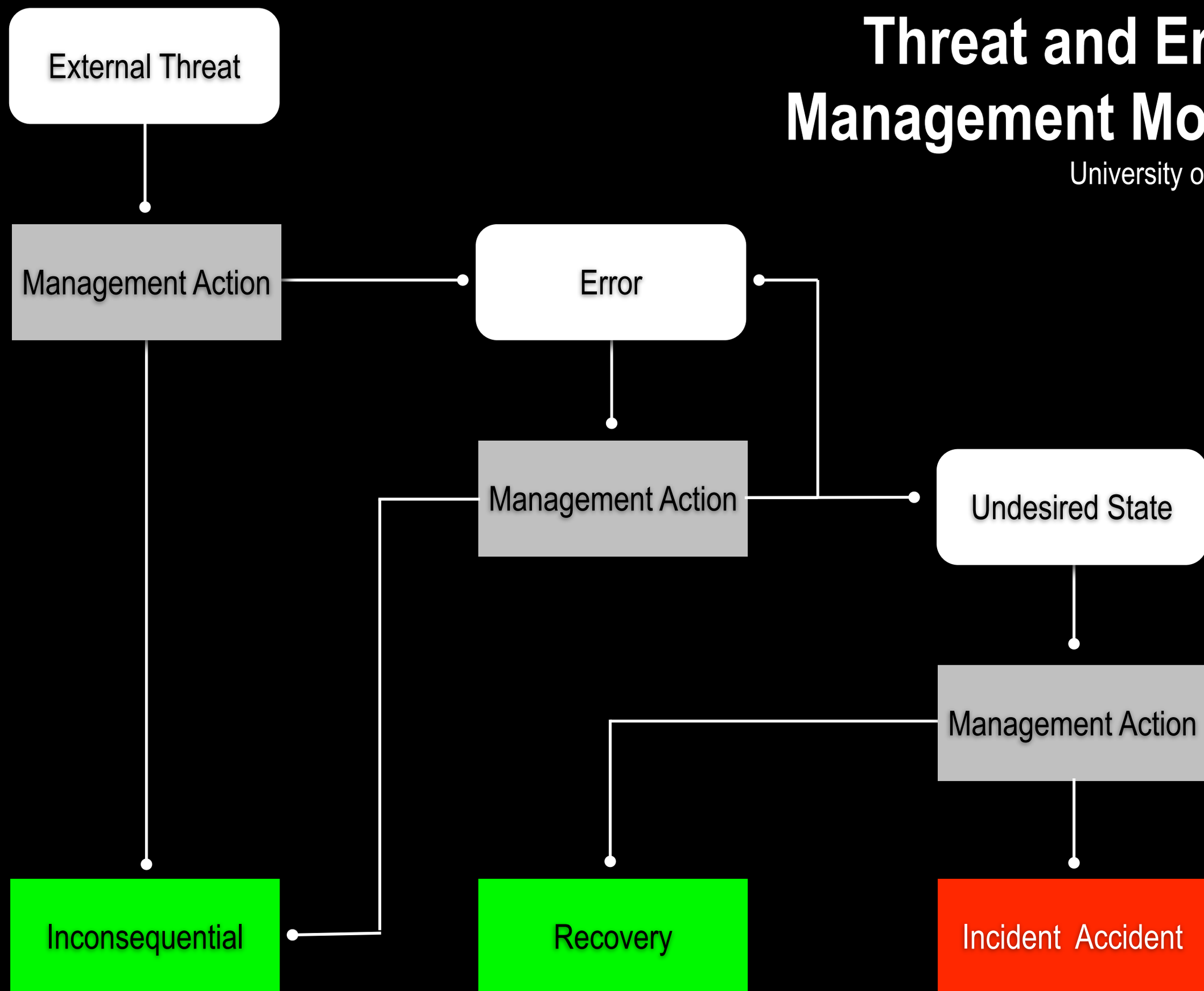
Threat and Error Management Model

University of Texas



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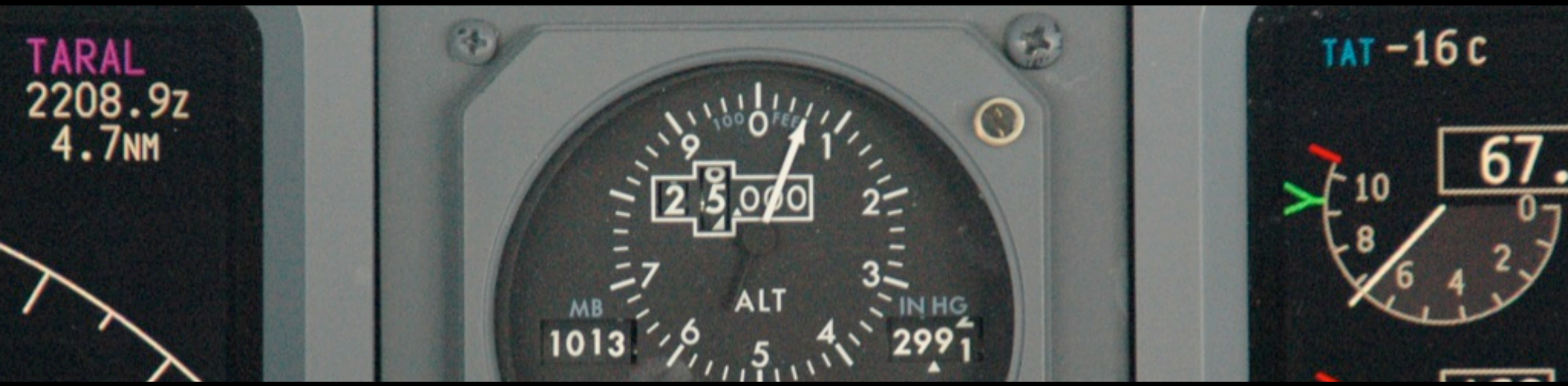
Results - TEM



Threat Management

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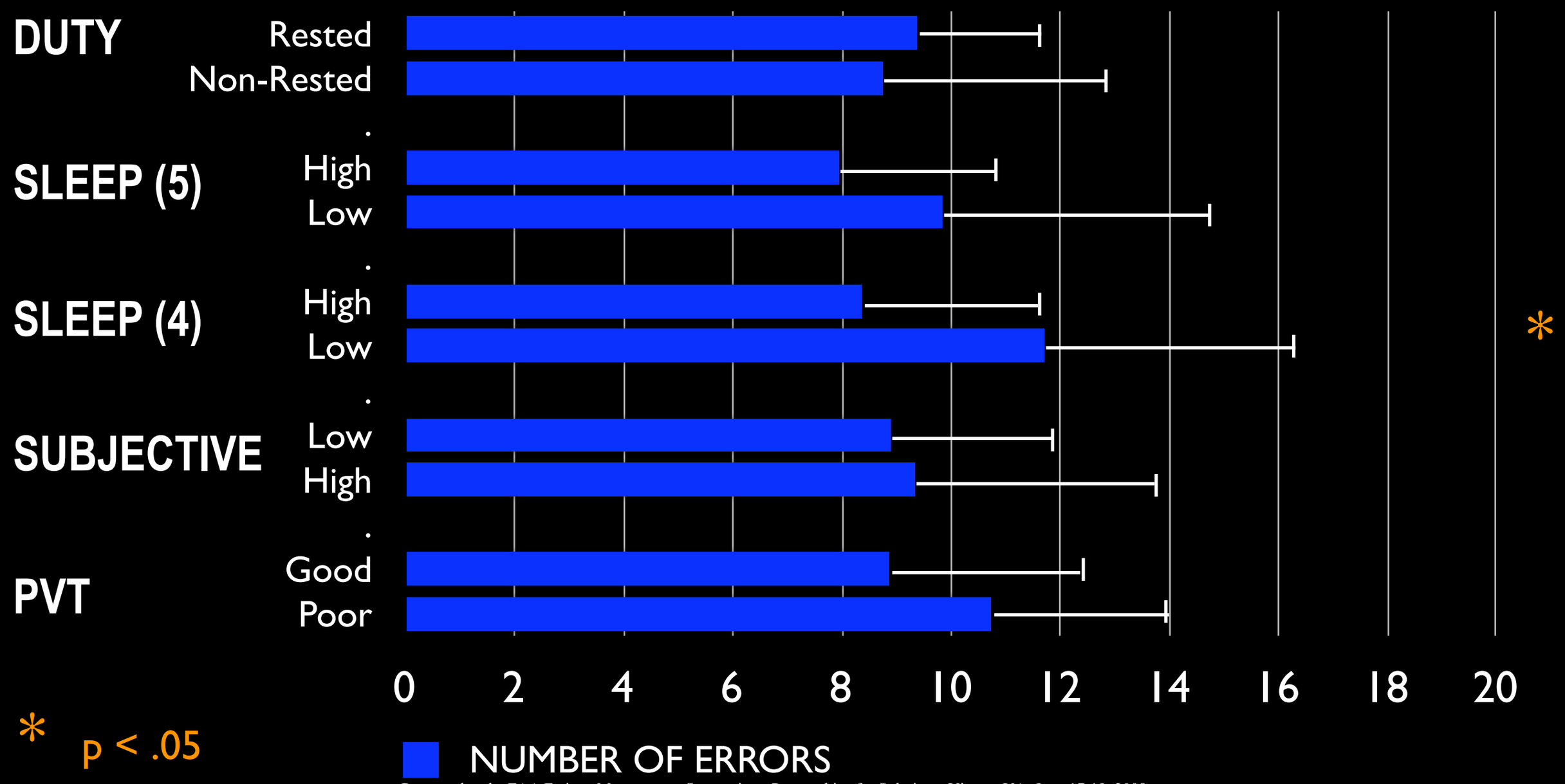
Overall Error Rate



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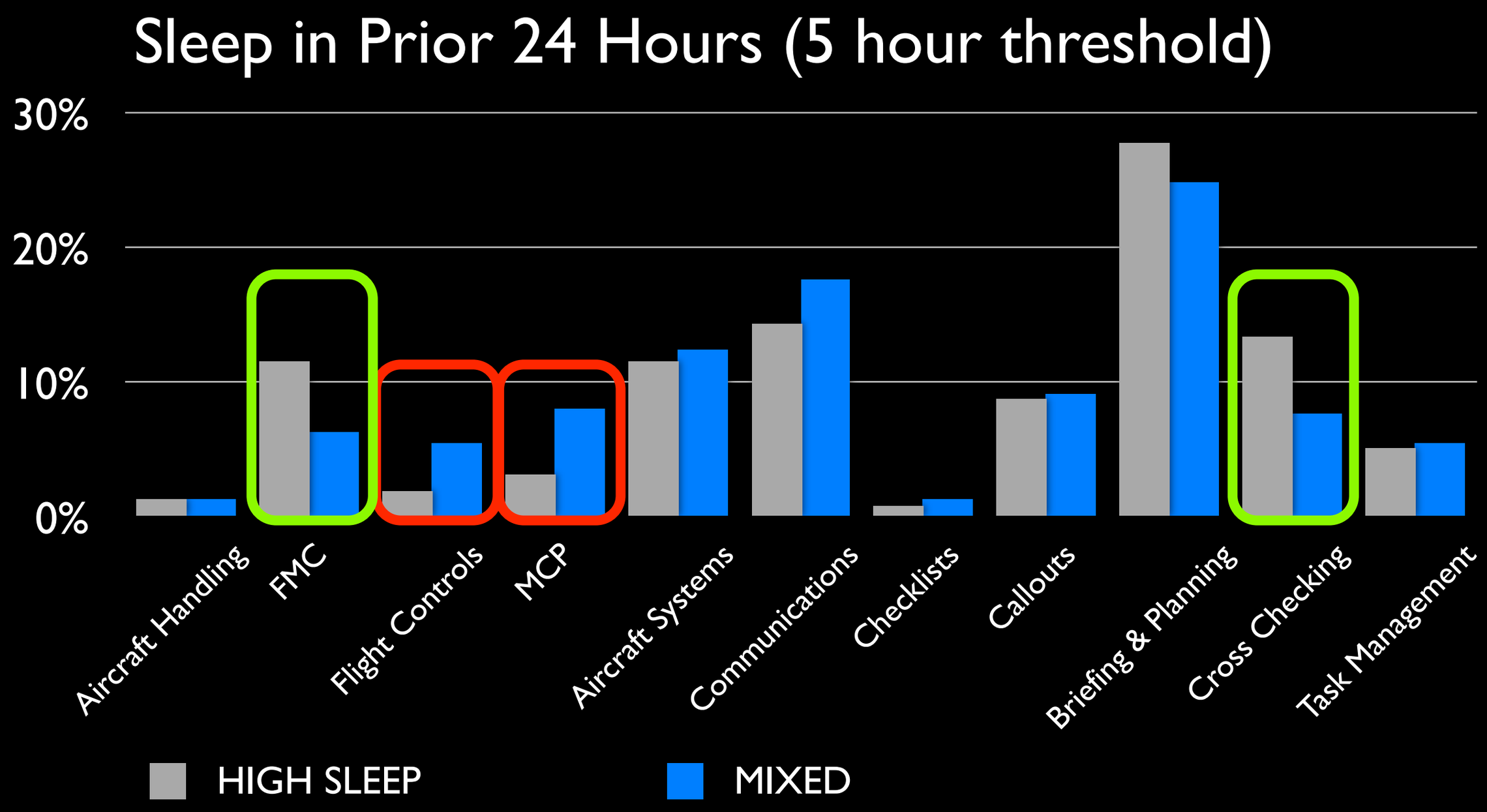
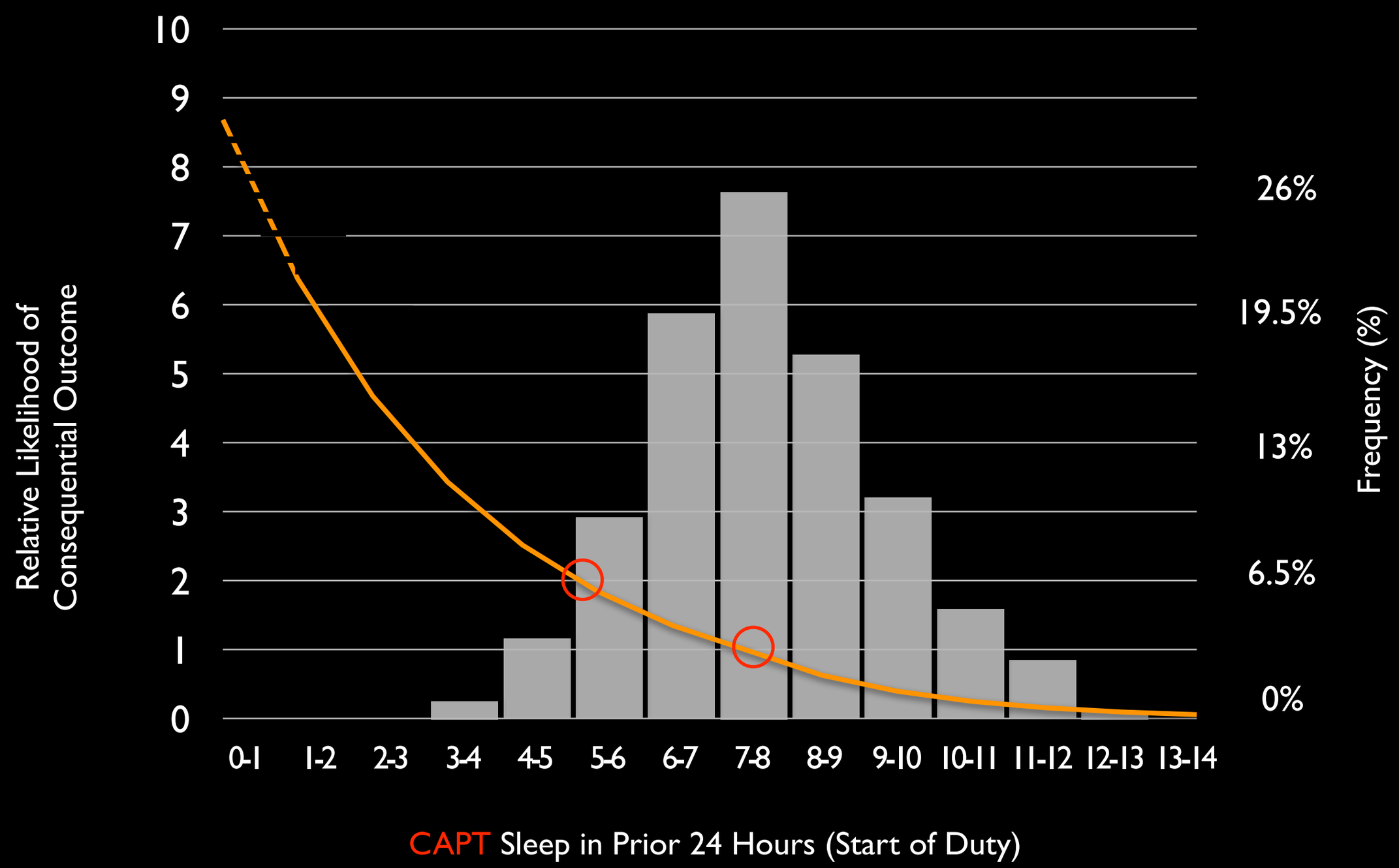
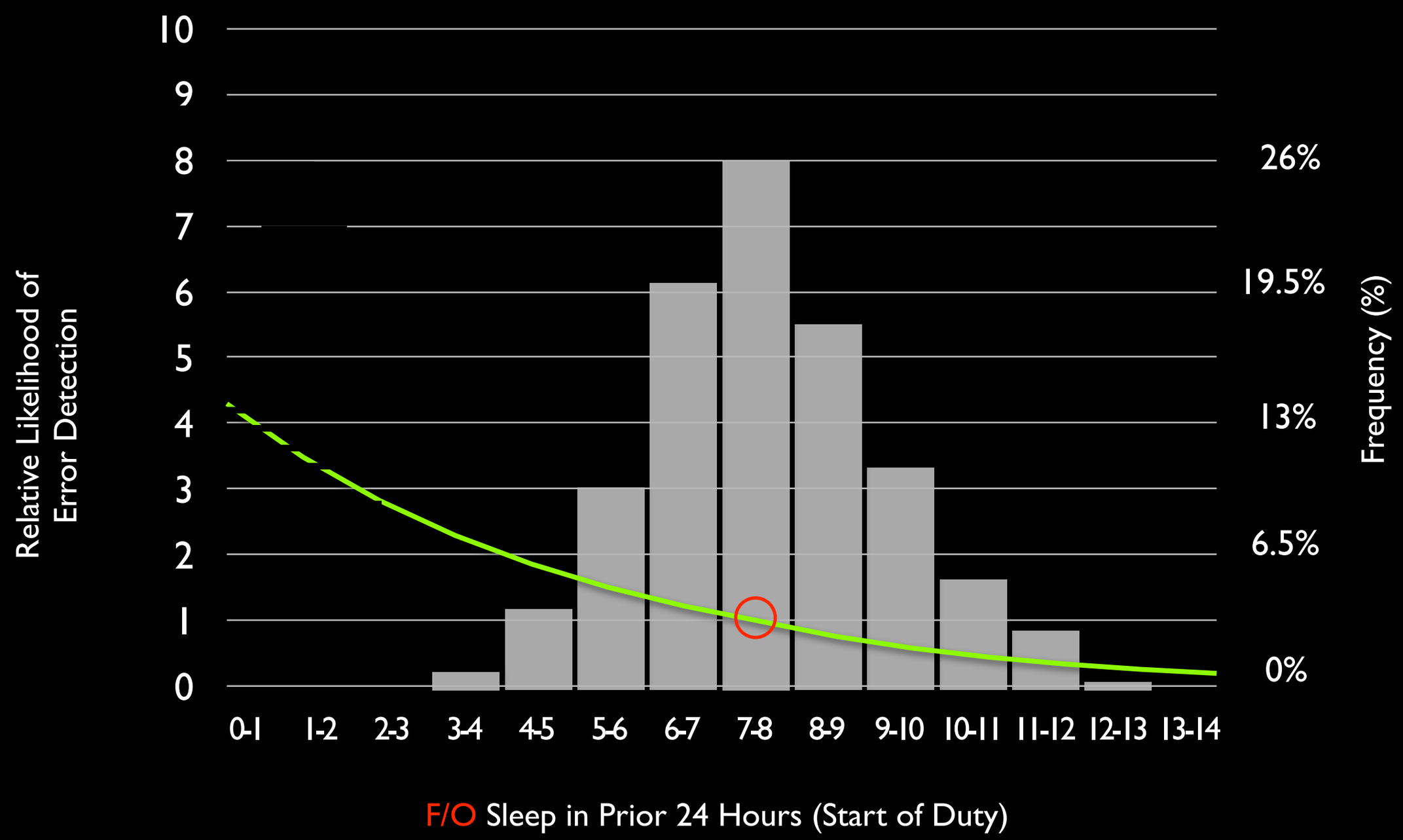
Error Type


Sleep in Prior 24 Hours (5 hour threshold)
30%
20%
10%
0%
Aircraft Handling
FMC
Flight Controls
MCP
Aircraft Systems
Communications
Checklists
Callouts
Briefing & Planning
Cross Checking
Task Management
HIGH SLEEP
MIXED

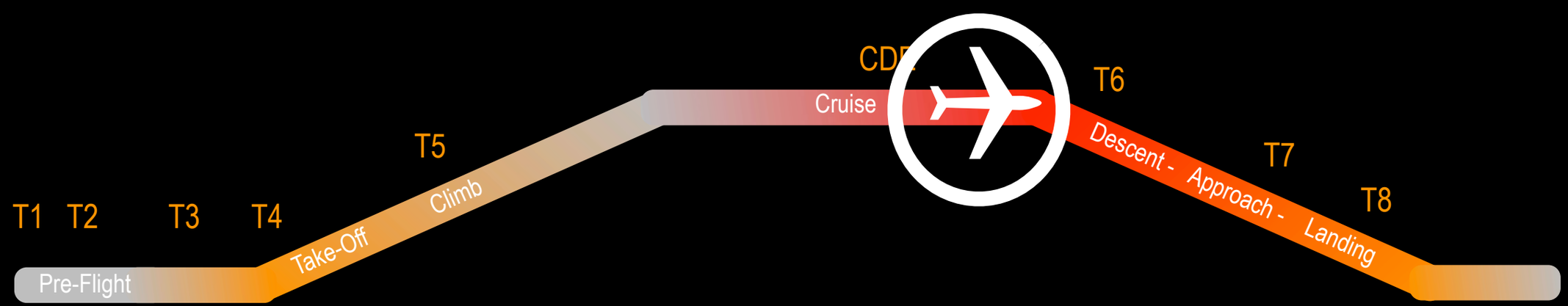
Likelihood of Error Mismanagement



Likelihood of Error Detection



Scenario Structure



workload

T1 Dispatch with Thrust Reverser "Locked Out"

T2 Change in Loadsheet

T3 Change in Duty RWY

T4 Clearance to Lower Altitude on Departure

T5 Higher Cruise Level & Expedite Climb

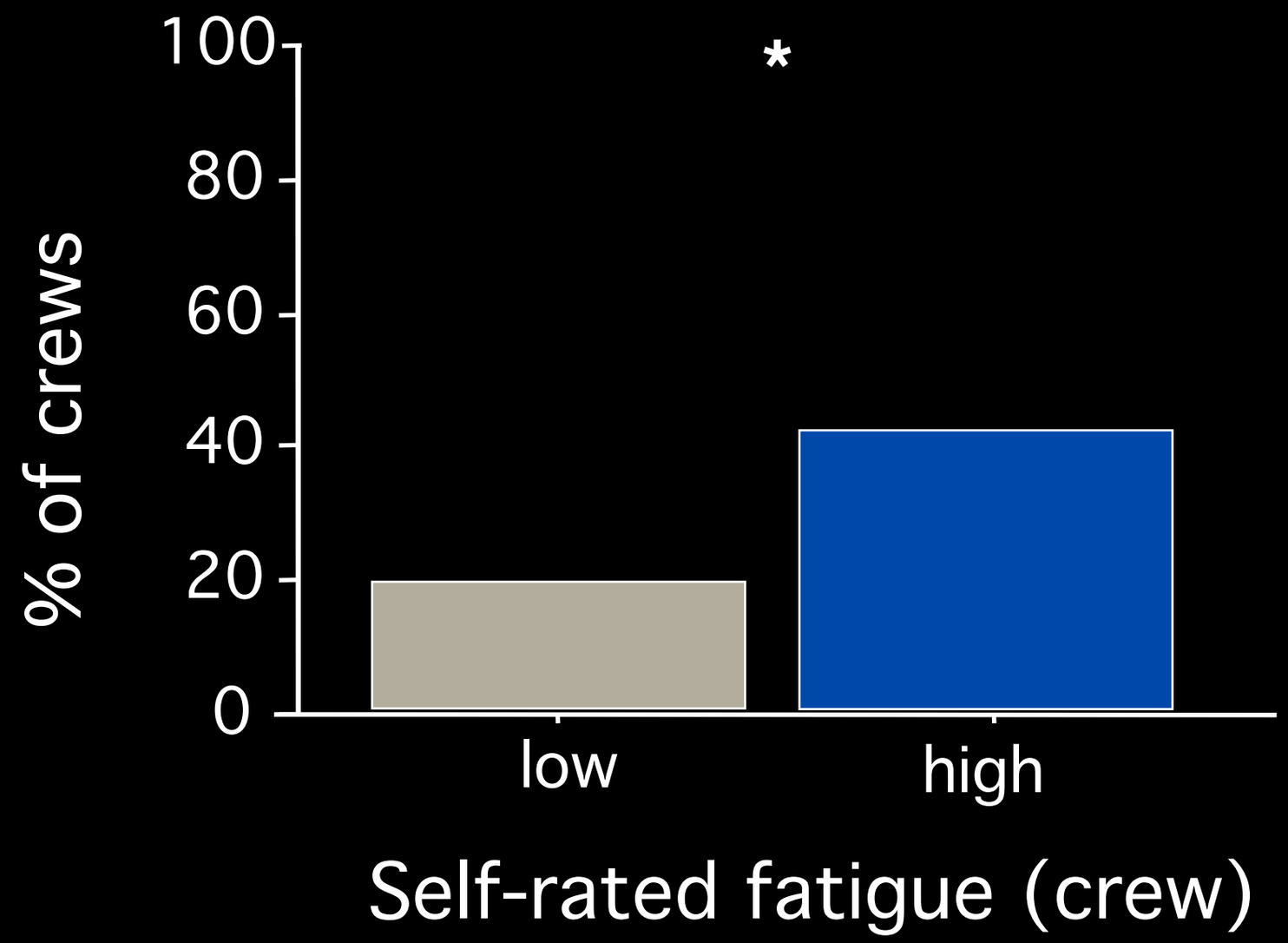
CDE Critical Decision Event

T6 High Speed Descent & Track Shortening

T7 ATC QNH Error

T8 Failure to Provide Clearance to Land

Diversion



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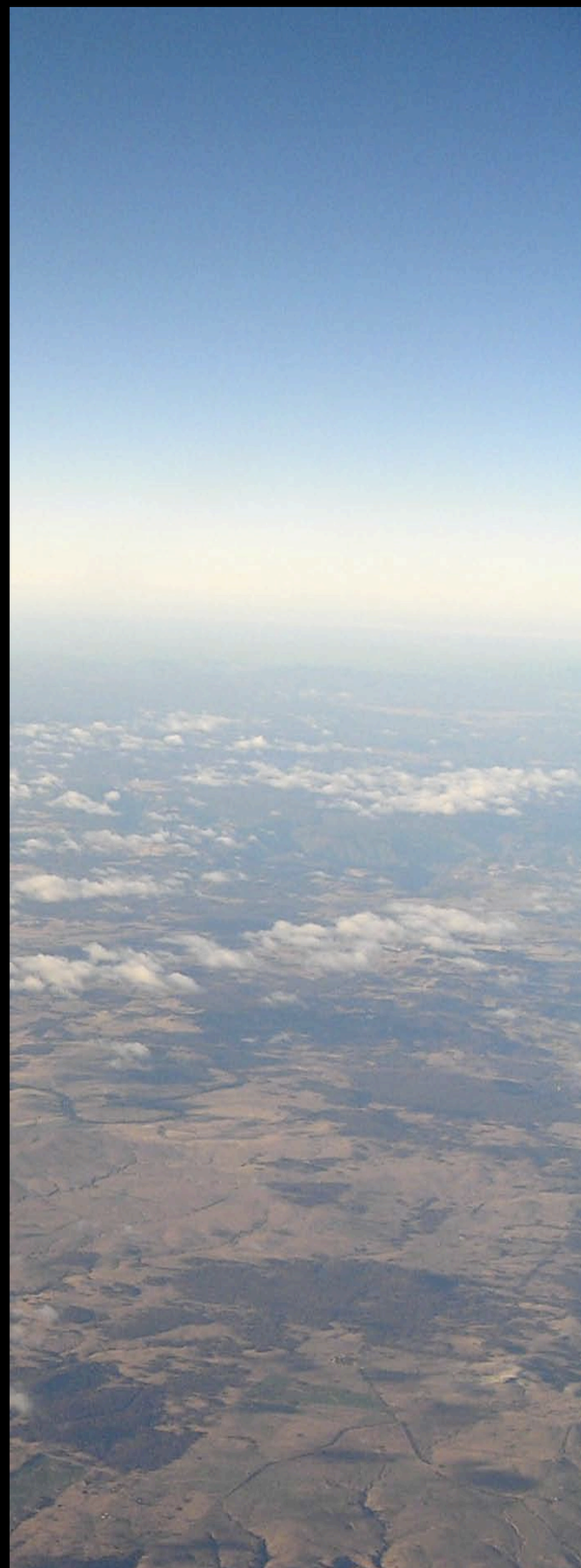
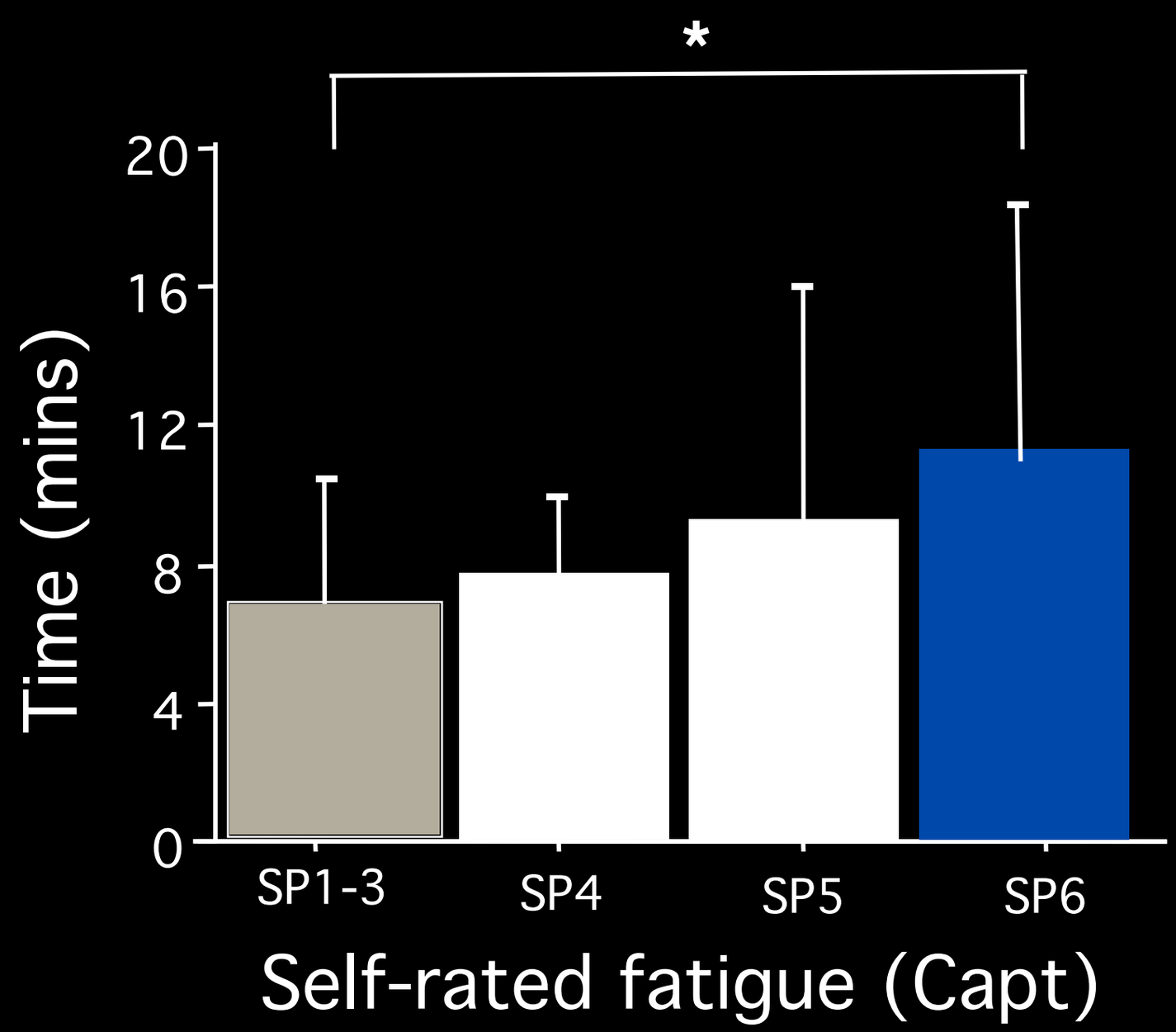
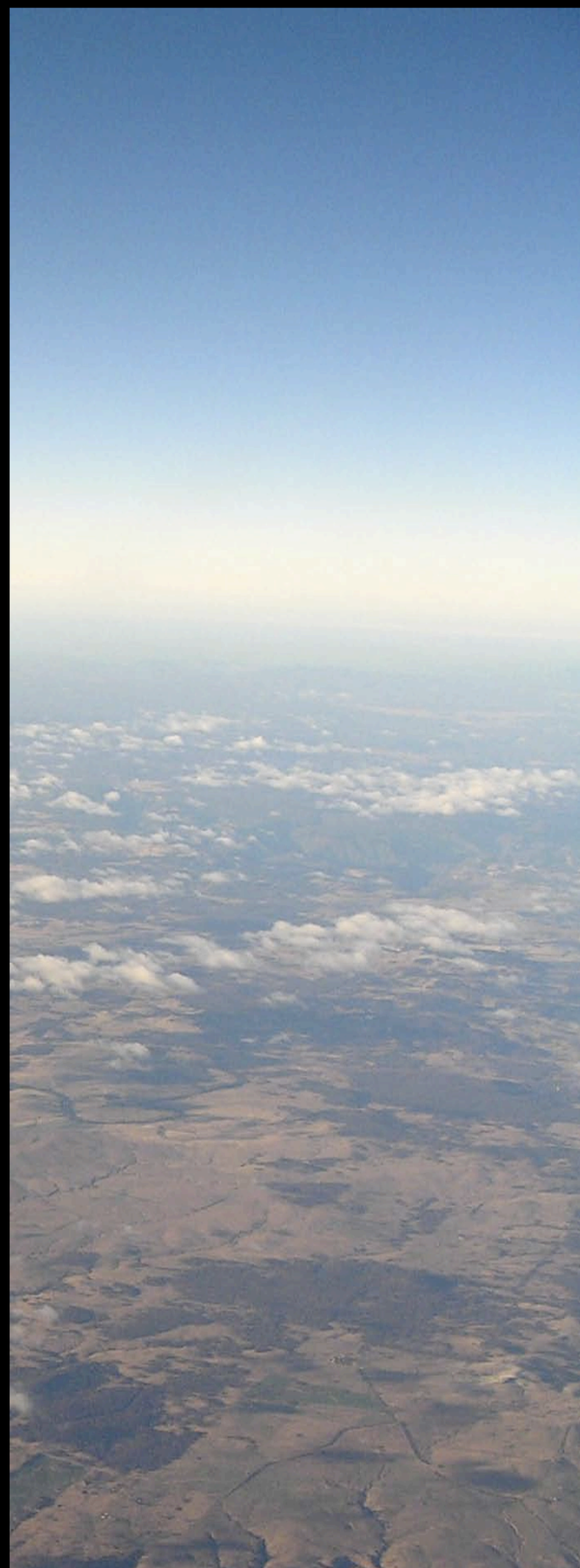


Time to decision





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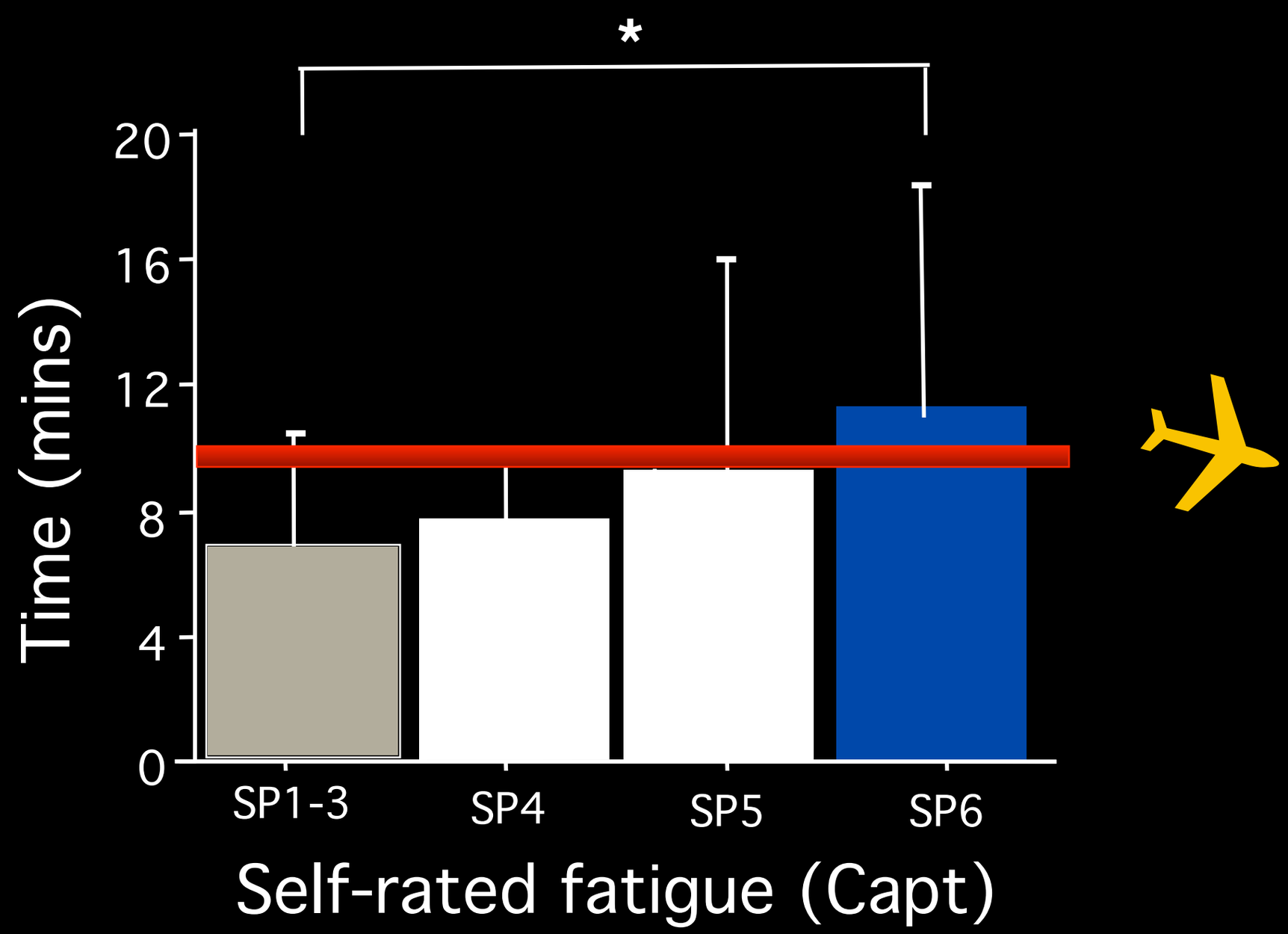
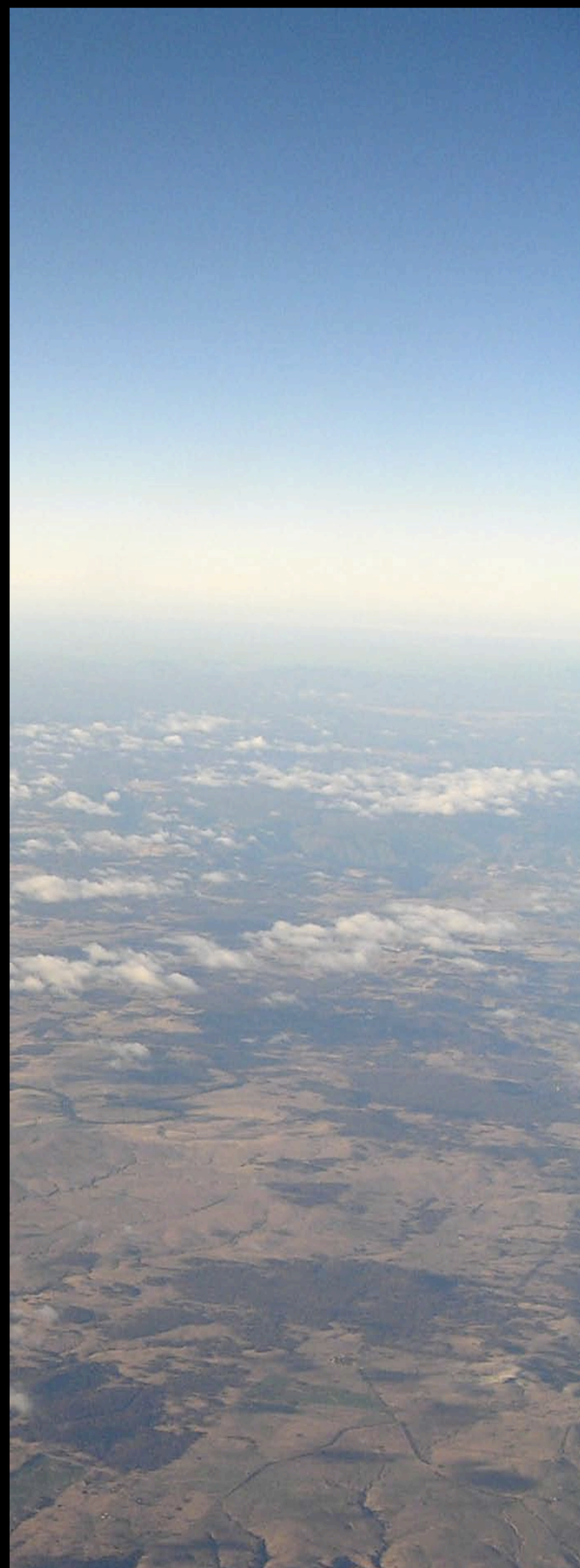
Time to decision





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Key lessons…

ALTITUDE
VERT SPEED
A/P ENGAGE
COURSE
10000
CMD A
CMD B
335
CWS A
CWS B
DN
UP
F/D
ON
DISENGAGE
ALT HLD
V/S
RADIO
MINS
BARO
RST
FPV
MTRS
STD
VOR 1
OFF
ADF 1
VOR
MAP
CTR
TFC
VOR 2
OFF
ADF 2
WXR
STA
WPT
ARPT
DATA
POS
TERR

Key lessons...

Fatigue is not simply equated with impaired performance

Performance Protection

- Improved Cross-Checking
- Higher rates of Error Detection
- Reallocation of cognitive resources?

Performance Impairment

- Higher rates of error occurrence
- Higher rates of error mismanagement
- Longer decision-making time
- Limits of compensatory mental effort?

Key lessons...

Sleep was the most consistent predictor of changes in performance

Its all about sleep...

- Significant differences in performance when sleep in prior 24 hours drops below 5 hours
- Reinforces sleep as a critical component of FRMS

Tasks appear to be differentially "vulnerable"

Its not all about time available...

- When time is available - tasks appear to be more resilient
- However, changes in decision-making were also evident

Key lessons...

Important Lessons for Error Tolerant Design and "Fatigue Markers"

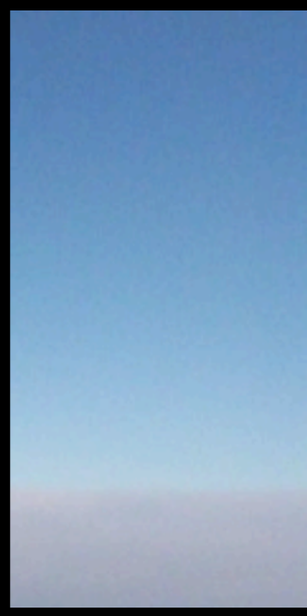
Vulnerabilities

- Prospective Memory
- Susceptibility to Expectation Bias
- Degraded External Situation Awareness

Just the beginning of a much greater understanding of fatigue

Current and future work

- LOSA, FOQA, and other data sources
- In the truest sense of SMS, bringing together multiple data sources

Thank you...

http://www.unisa.edu.au/safety