

Medical Issues in Aviation

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Flight Crew, Circadian Rhythms, Fatigue,
Alertness & Long Haul Operations

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Fatigue and alertness :

- Rest and sleep
- Time since awake
- Type of activity
 - Manual
 - Mental
- Time on task
- Type of task
 - Monotony/Boredom
 - Challenging
- Circadian rhythm
- Drugs/Medication/Aids to alertness



Measuring Fatigue:

Wouldn't it be nice?



Can Fatigue be measured?

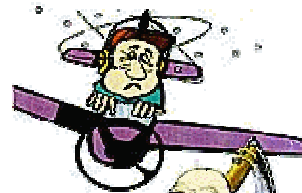
Physical: Yes

Mental: No



Research Ongoing -- US Navy Studies

Alcohol Equivalence :
Caution!!! In Using
Such measures



Surrogate Measures eg.
Karolinska / Stanford Scales

Concept of **AVOIDANCE** of Fatigue



Can Alertness Be Measured?

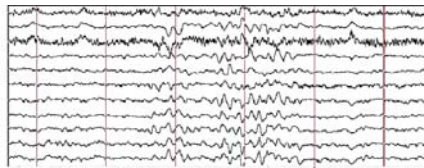
*Sleep Vs Wakefulness -- EEG
(Polysomnography)

*Psychomotor Vigilance Tests:

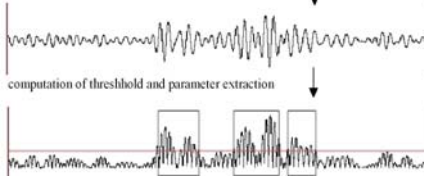
- Simple Reaction Time
- Choice Reaction Time
- Tracking Tasks
- etc

*Performance Based Measures:
LOSA, FOQA etc

Polysomnography:



Fast transformation (electrode O₂)



Spectral Frequency Analysis

Sleep Scoring

•“Gold” Standard for measuring Quantity & Quality of Sleep and the study of Sleep Disorders.

•Has been used on a small scale by some scientists to measure alertness.



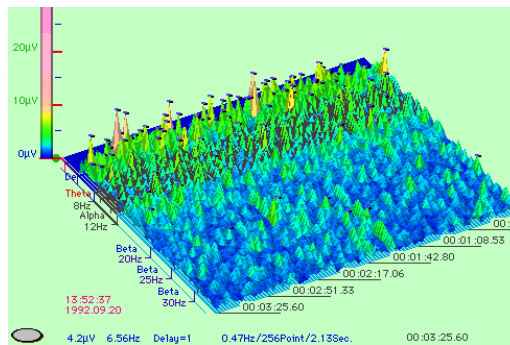
•Initially with EEG only.

•EEG + EOG



Spectral Analysis:

Calculate power in the different frequencies, especially those that indicate “changes” in alertness



Problems:

- This approach is relatively new
- Does not have accepted international standards
- Considerable difference in spectral power between people: Meaningful comparisons cannot be made
- Large amount of artefact in recording, making much of the data unusable
- Not done on wide spectrum of flights: ? Compare

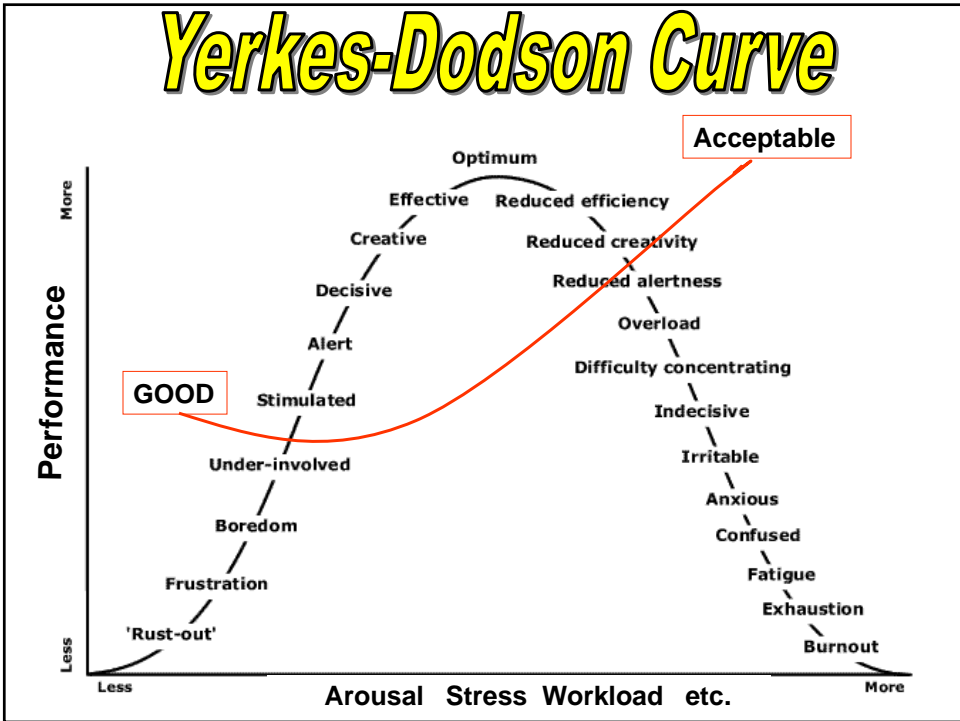
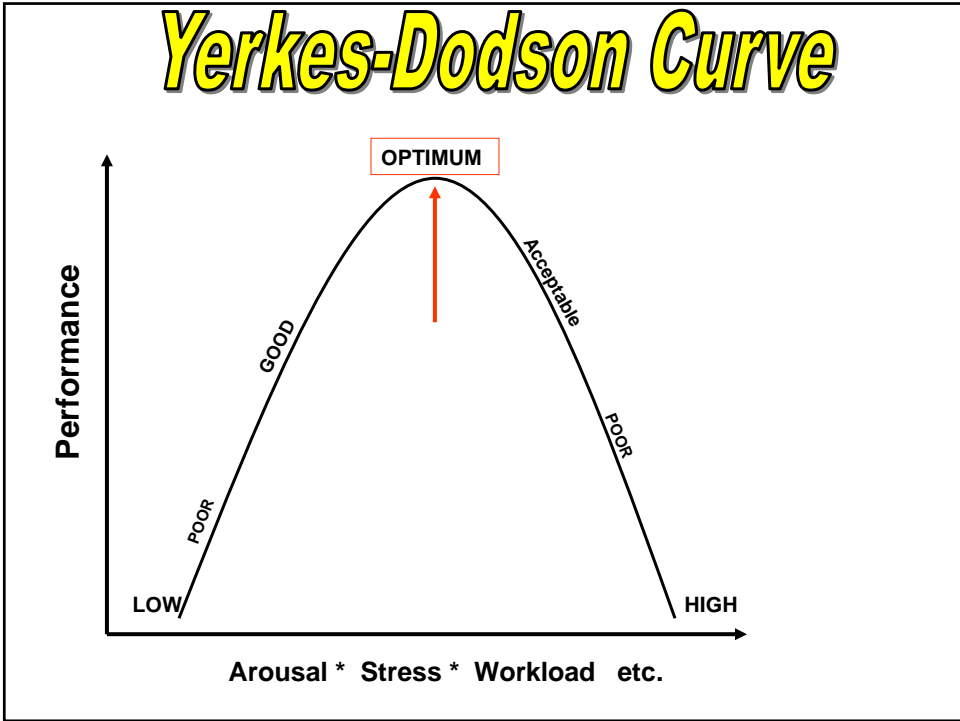
Sleep Scoring:

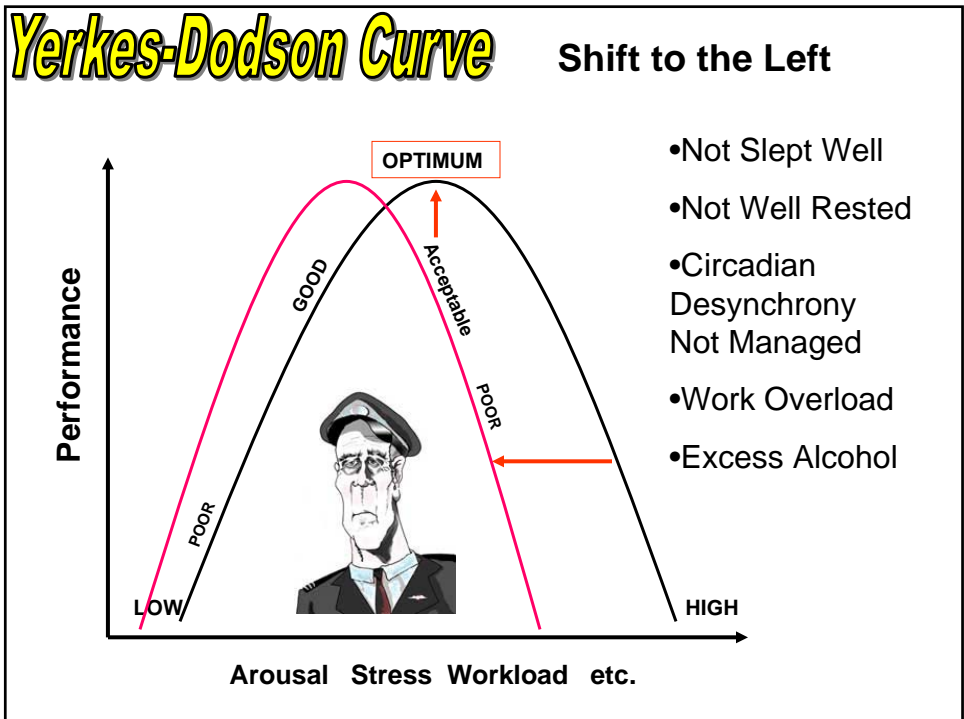
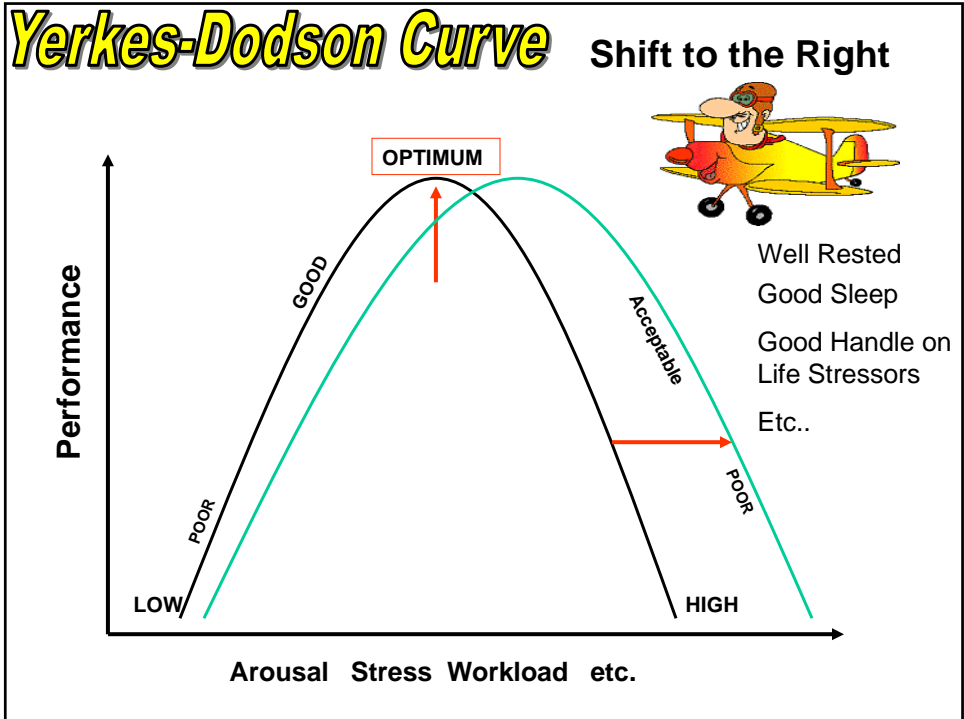
Use standard criteria for sleep (albeit slightly modified); View data for known signs of drowsiness/sleep and categorize into levels of alertness.

Problems:

- Not the conventional way of using the data: ?? International acceptance.
- Very little is known about how much drowsiness or unintentional sleep is “normal” in the full spectrum of flights.
- Visual scoring of data: Only large scale changes can be detected.
- Artefacts in data.
- Comparison with ??







General Idea:

Build up reserves

Spare mental capacity



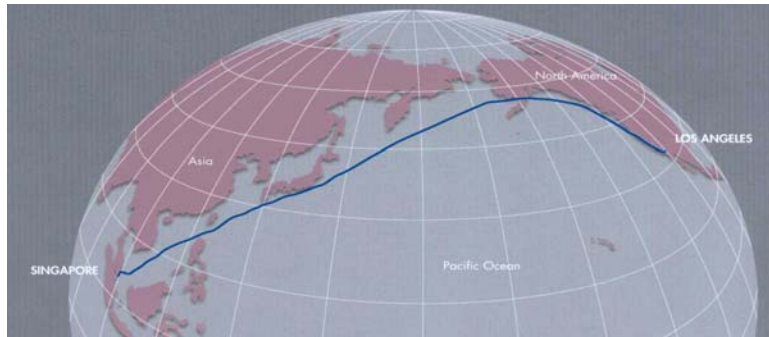
NOT a good example of a person with reserves and spare mental capacity

In the Aviation World

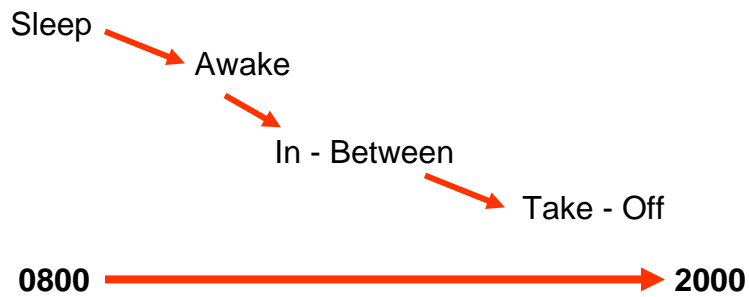
Rest & Sleep

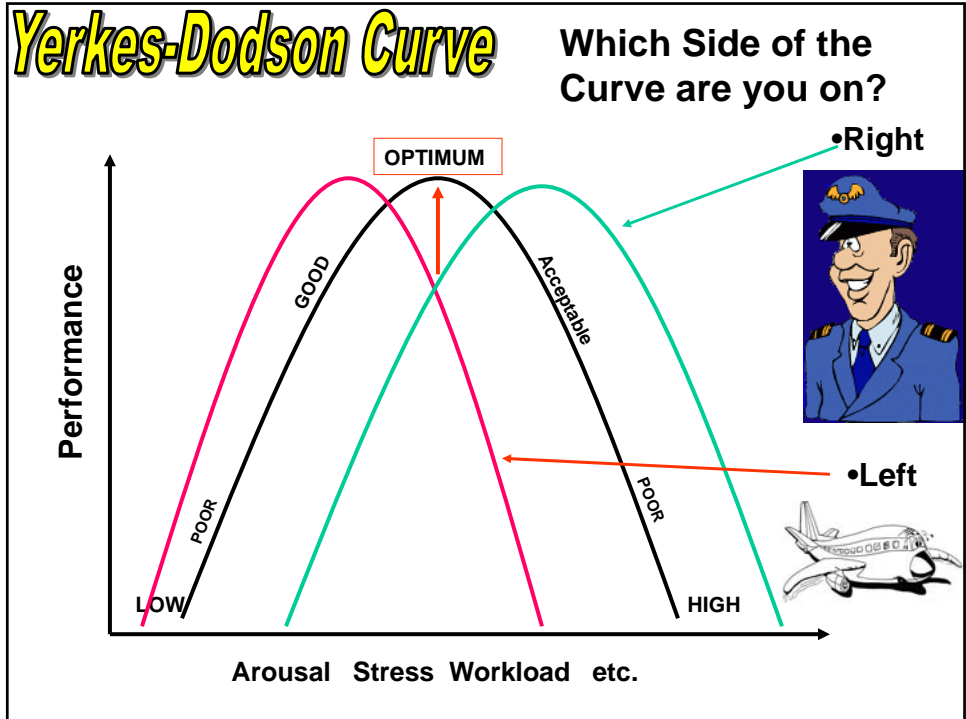


Circadian Desynchrony



Time Since Awake






TYPE OF ACTIVITY

PHYSICAL

MENTAL

Vs

Time On Task
Remember Yerkes-Dodson!
Type Of Task

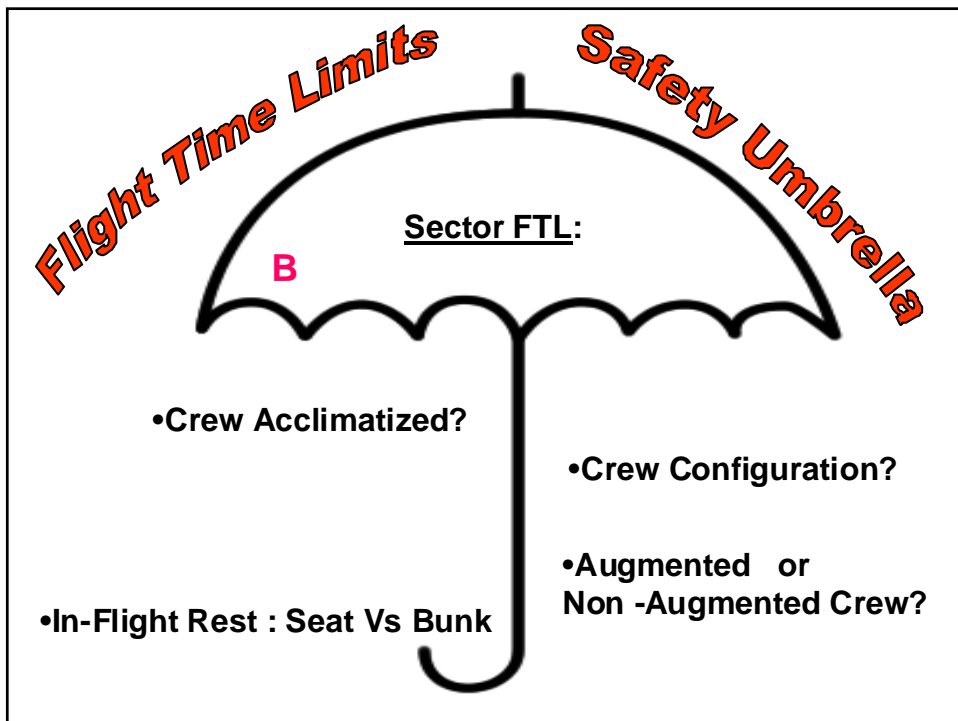
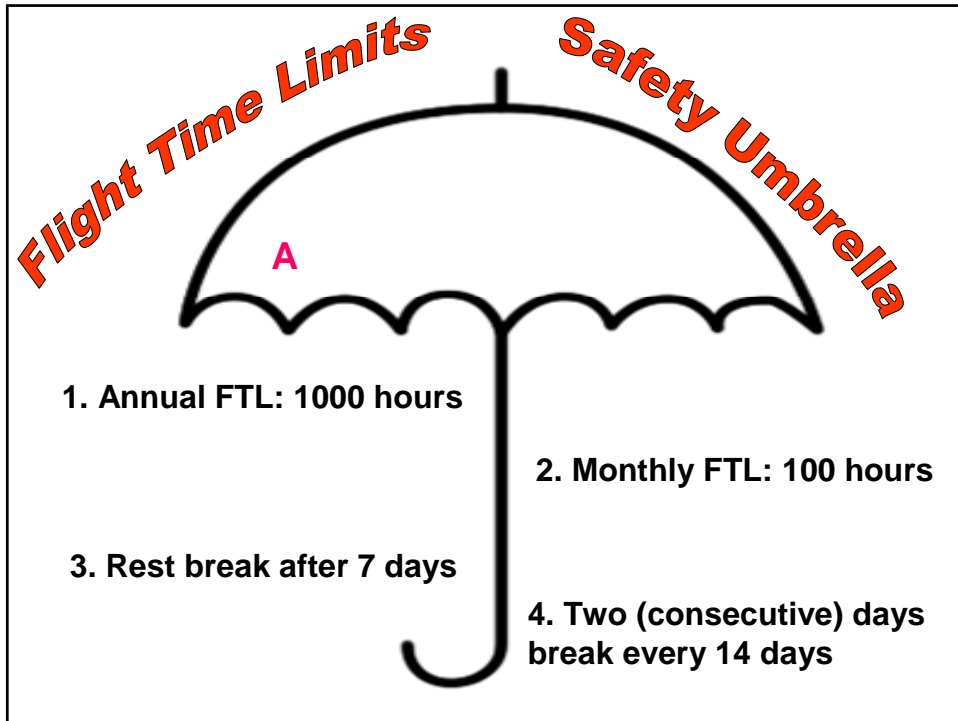


Cockpit Environment
Cockpit Environment

Flight Time Limits...

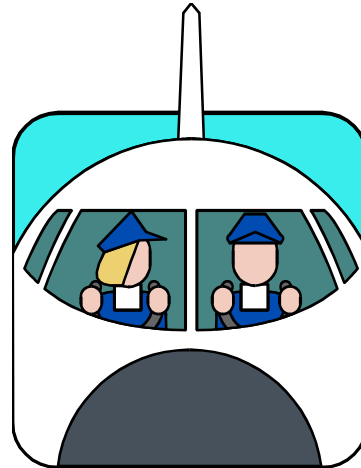


.... **in Aviation**

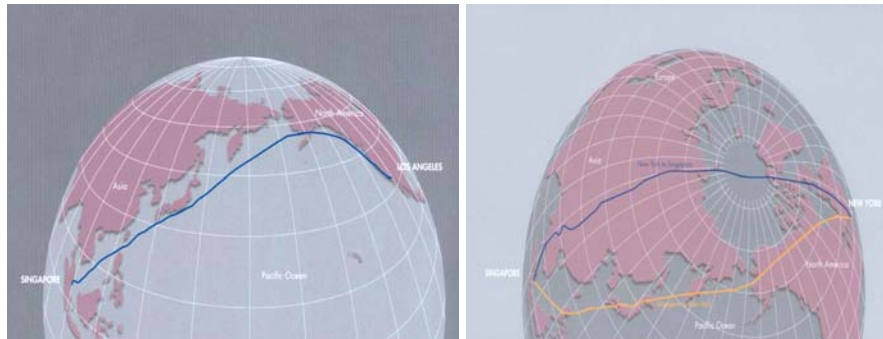


Factors that moderate alertness/fatigue on the flight deck:

- Number of flight crew
- Composition of flight crew
- Status of circadian acclimatization
- Previous duty duration
- Opportunity for pre-flight rest/sleep
- Opportunity for in-flight rest/sleep
- Post-flight recovery and sleep



Ultra Long Range Flights



What were the issues to be resolved?

What Were We Up Against ??

Existing Flight Time Limit: 16 hours

Existing Flight Duty Period(FDP): 18 hours



Estimated **Flight Time for ULR**
flight sector: 18+ hours



Estimated **FDP for ULR** Sector: 20+ Hours



If Delay/Disruption of 3 hours is included
work day could become 23+ hours



Issues That Had To Be Resolved:

1. The Existing Flight Time Limits Would Be Exceeded

• *Perceived "Upper Limits" To Be Breached*



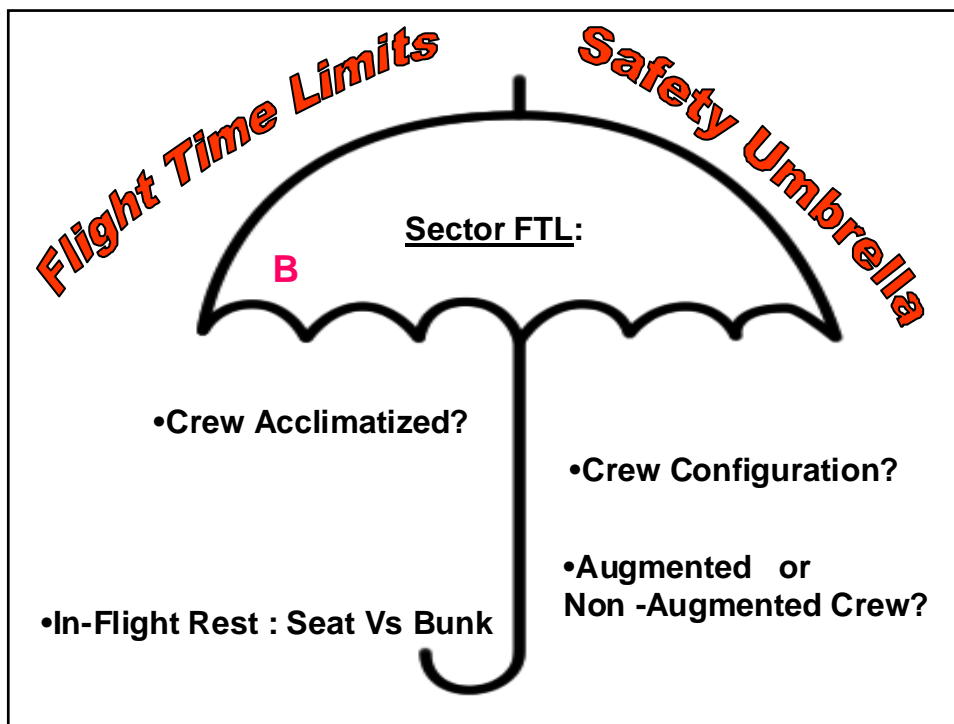
• *Would Flight Safety Be Compromised?*



2. Could Alertness Be Sustained Over Such A Long Flight

• *If Possible --- How?*








Resolving The Issues

- 1. Tripartite Approach**

 - Involve All Stakeholders
- 2. Involvement of International Aviation Community**

 - Other Regulators
 - IFALPA
 - Aircraft Manufacturers
- 3. Scientific Guidance**

 - Internationally Reputed Scientists
 - Experienced In FTL Research

Lessons From ULR Studies



Departure windows that factor in circadian shifts and a systematically thought out plan for rest/sleep in the overall duty cycle, alongside appropriate crewing, are the key to maintaining alertness.

Aids To Sleep & Alertness

Alertness

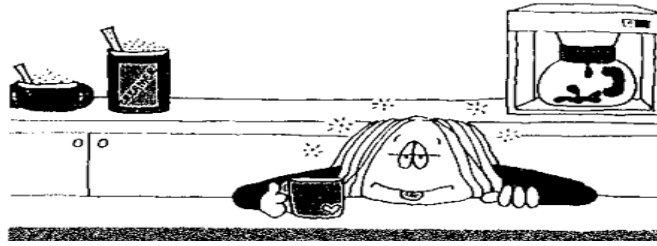
Sleep ***ZZZZZZZZZZ***

Relaxation

Aids to Alertness

C
O
F
F
E
E

Before

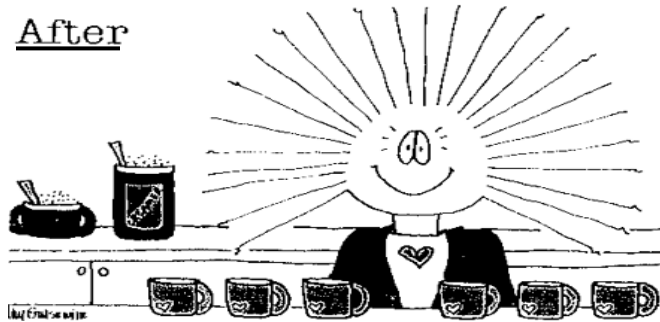


Coffee

Time of
Consumption
and Amount
Consumed are
Important

Within the Duty / Rest Cycle

After





Sleeping Aids



What a coincidence, so does he

Melatonin

Hormone produced mainly in Pineal gland

Regulates circadian rhythm in the normal dark/light cycle



?Assist in jet-lag

Should a pilot use it?

When to use it

NOT a good

Sleeping aid !

Sleep Hygiene...ZZZZZZZZ

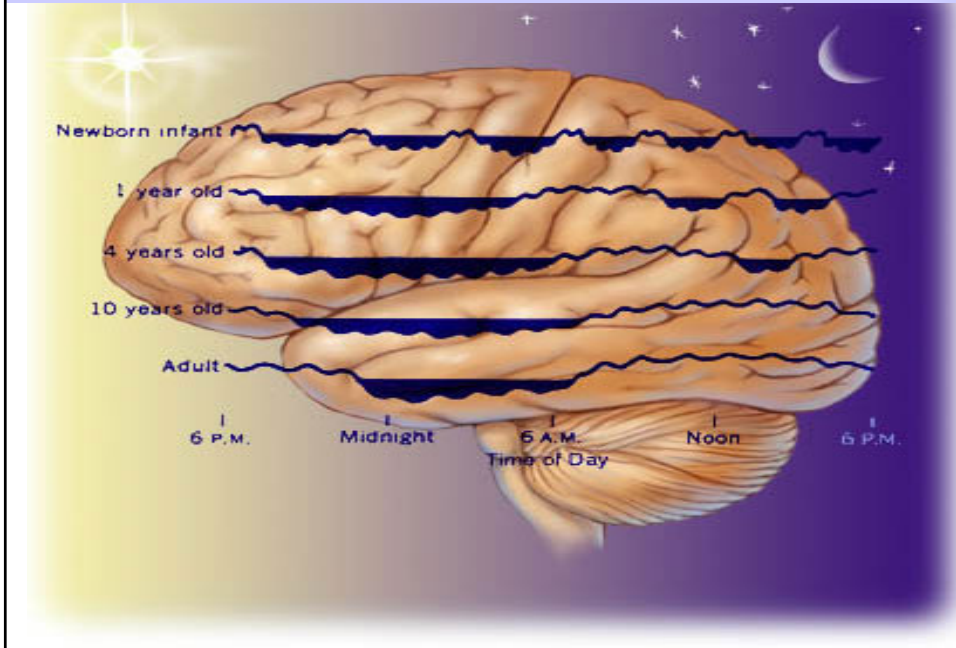
Humans (like all animals) are creatures of habit

Establish sleep habits --- follow the routine

Healthy Life Style Essential

Moderation is the key

Sleep structure across the ages



The Bedroom.....

**H
O
M
E**



**H
O
T
E
L**

..... for sleep only

OK, Provided You

Get Some Sleep As Well !!

Definitely Not Recommended

Zeitgerbers

Entrain the Circadian clock

eg. Light vs Dark



Some FTL Issues That Will Challenge Regulators & Airlines



Current Flight Time Limits (FTLs)



Based Upon "Bader" Report



1970s



**** Outdated**



Major Revision Required

**** Withstood Test of Time**

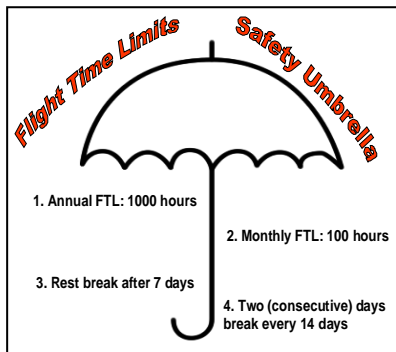


Minor "Tweaking"

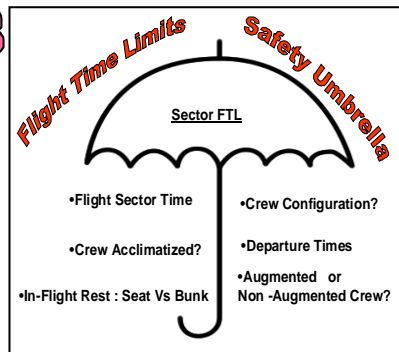
Proponents of major revision want both umbrellas removed and new regulations crafted

Will require large scale fatigue studies

A

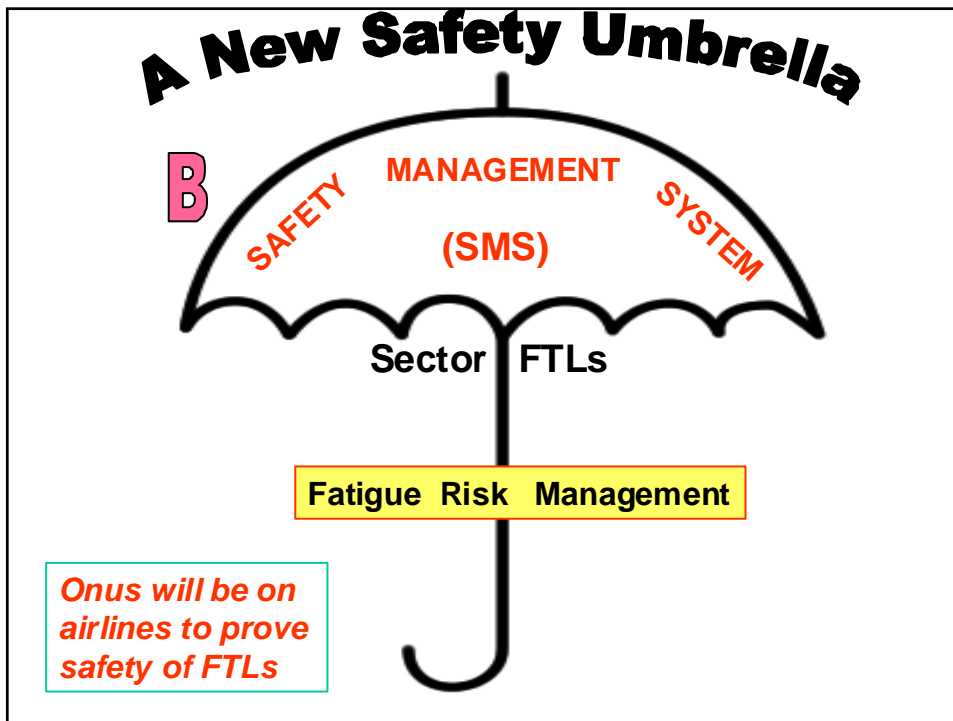
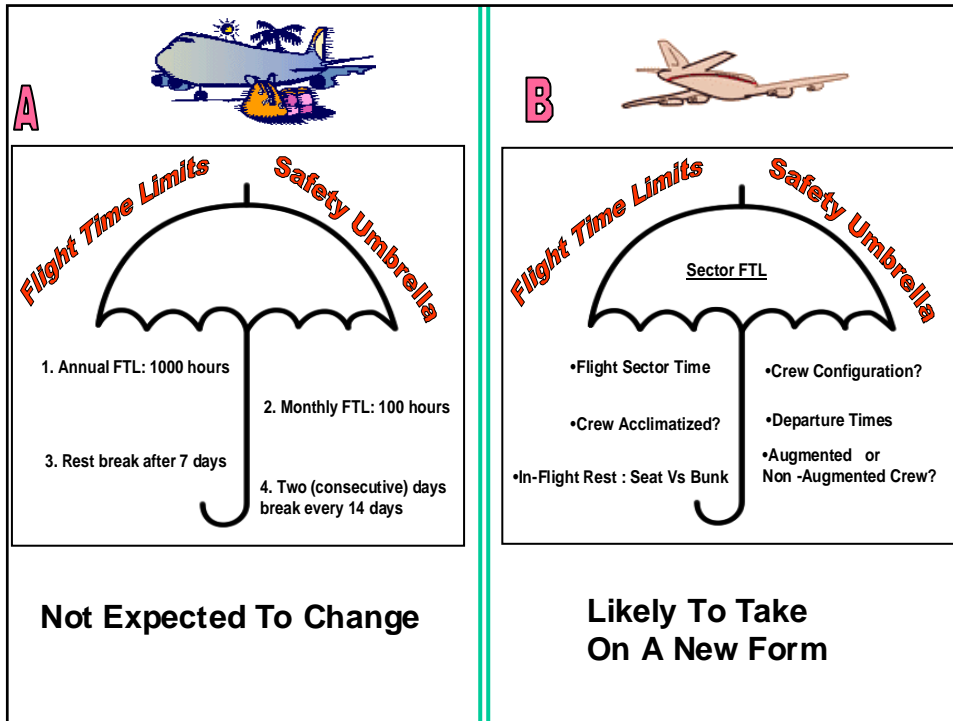


B



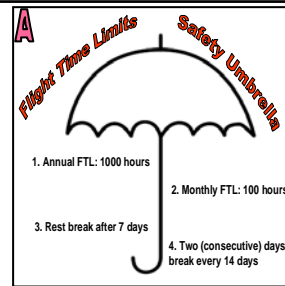
Other group want to retain umbrella "A" and tweak "B"

Similar to what we did for the ULR flights



Flight Time Limits:

Targets to be achieved or limits to be approached with caution?



Regulator

- Safety Umbrella
- Rest Opportunities

Pilot

- Human beings
- Conflicts between expectations and realities of life

Airline

- Maximize Crew
- Expectations on crew

Challenge: A Harmonious Resolution Of These Conflicts

Flight Time Limits:

→ Targets to be achieved or limits to be approached with caution?

Regulator

- Set Upper Limits

Pilot

- Approach with Caution
- Can Achieve If Paid More

Airline

- Maximize Crew
- Try And Achieve Limits

Challenge: A Harmonious Resolution Of These Conflicts

Hygiene Factors ?



"Avoidance" of Fatigue

→ CAP 371

We know the factors leading to fatigue.

Fatigue is difficult to quantify

“Cut-off” points for fatigue cannot be determined

Avoidance of Fatigue Factors is the BEST Bet






Proponents of Fatigue Risk Management



Are Saying The Same Thing

It Is Just Packaged Differently

Summary

1. Fatigue remains a problem among pilots 
2. Regulators, Pilots and Airline Operators all have a part to play 
3. Current regulations (FTLs) require revision 
4. Definitions within the regulations need to be crafted/refined to remove ambiguity (of interpretation) 
5. Overarching prescriptive limits likely to remain 
6. Fatigue Risk Management will come in within the ambit of the overarching prescriptive limits 