Flight Test G-WOE Module 2

Know Thyself

Error **Bites**™

Bite Back

GLOBAL WAR
ON **ERROR**®

www.g-woe.com

When you're surrounded by mediocrity, the first step is to turn your eyes upon yourself.

- Constance Castle

"The greatest battles are waged within."

The challenge of human error will never be remedied by any traditional safety program.

Personal error must be slowly untangled – in a private battle within each individual.

This is true because in high achievers, human error and personal weakness is secret and sacred ground.

<u>Everyone has a secret identity</u>, and until it manifests itself in an accident or compromised mission, it will never show up in the statistics and may never appear on anyone's radar screen as a problem.

Everybody's Got an Opinion

Where Lies Wisdom?

"I think all the mean people should just get together on their own island and blow each other up."

- Actress Tara Reid on how to deal with global terrorism
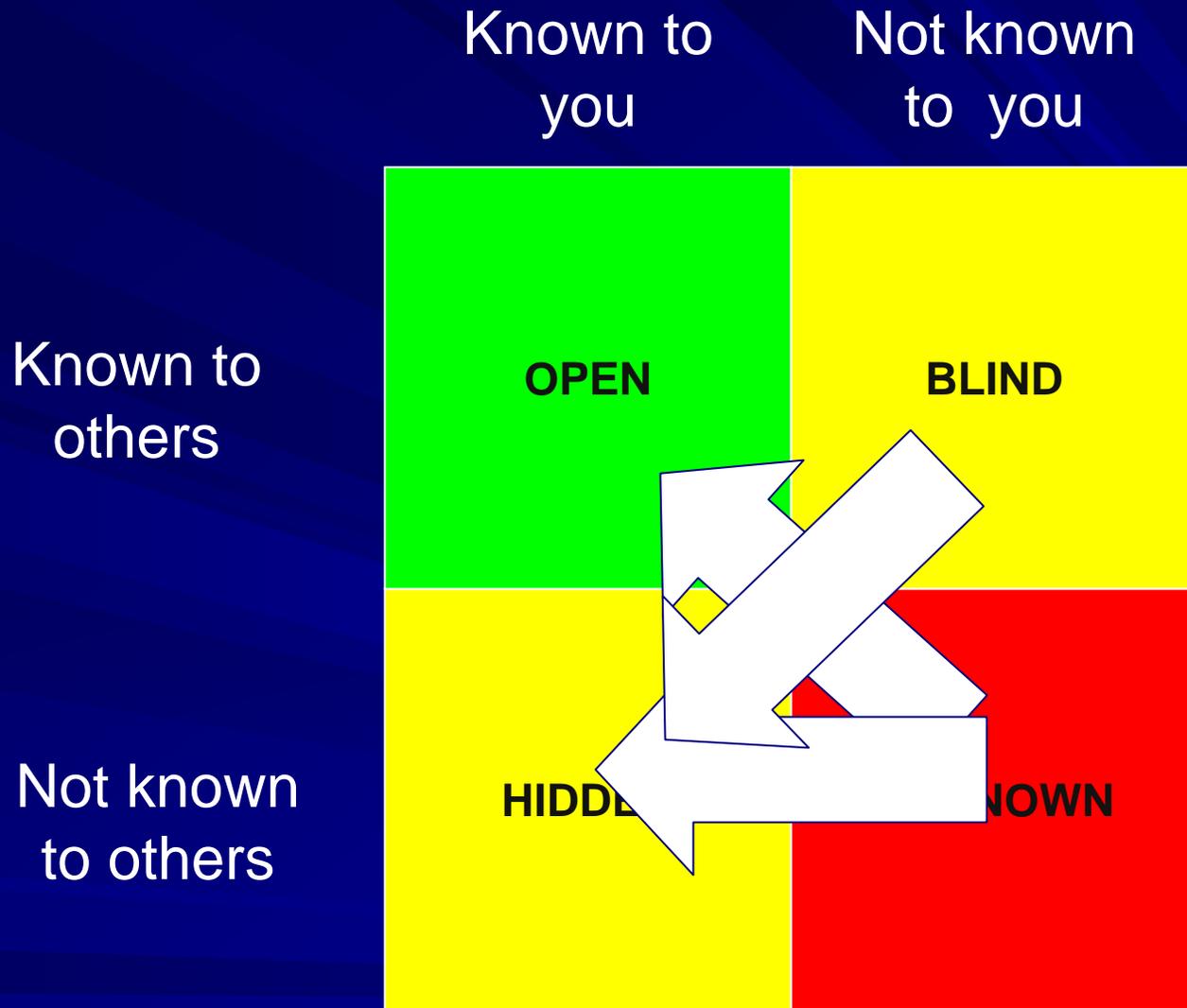
Before you fully trust yourself – learn how to know yourself.

Human Performance Improvement is a Self Service Affair – at Least in Part

➢ "If it is to be it is up to me."

➢ Without baseline understanding, any countermeasures feel like something done <u>to</u> you

➢ No buy in, no change

➢ Vital role of self-discovered truth

"If we continue to think of ourselves as shadowy users of our mystical brains we will be needlessly befuddled, not approach our potential and make unnecessary mistakes."

Dr. Stephen Pinker, Harvard

Airworthiness

Known reliability for flight envelope due to integrity of design, test & manufacture, plus inspection, detection, repair and maintenance of technical components

Err-worthiness

Known reliability for mission envelope due to integrity of training, evaluation and ongoing inspection, detection, repair and maintenance of human factors

Summarised sources of human error

Violations:
- Stem mainly from *motivational* factors
- They can only be understood in a *social context*
- They can be reduced by changing *attitudes/culture*
- Violations bring perpetrators into areas of increased risk, i.e. they are approaching the 'Edge'

Errors:
- Stem mainly from *informational* factors
- They are always *unintended*
- They can be rexplained by reference to *individuals*
- Their likelihood is reduced by *improving information*
- Errors occur in any situation

Human errors

Intended actions

Unintended actions

Basic error types

Violations + Mistakes + Lapses + Slips = Misadventure +
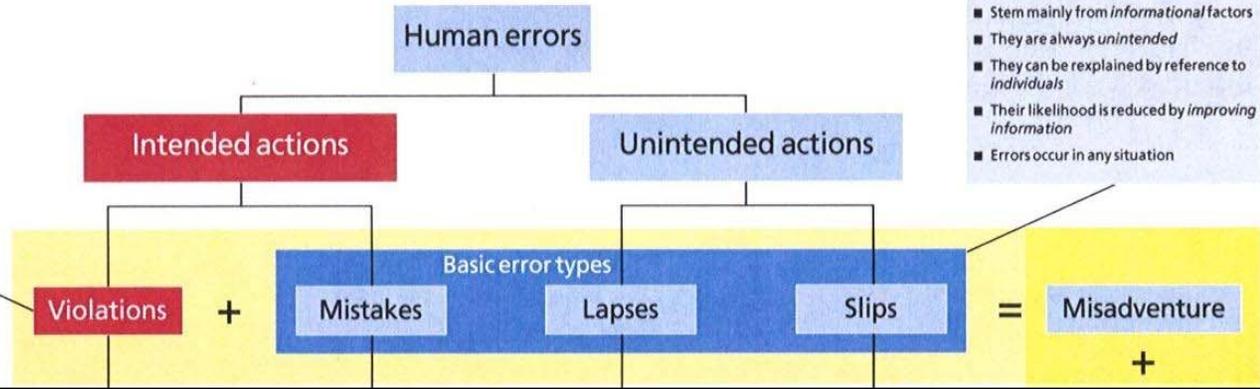
Habitual deviation from required practice. Almost invisible until there is an accident. Natural human tendency to take the path of least resistance. "We do it like this all the time..."

Often i...
from A...
instinct...
bored...
"I know...

The ap...
proble...
in the p...
other w...

Ad hoc...
in unfo...
Genera...
"Now t...

Delibe...
Almost impossible to proactively address.

to keep abreast of changes (creeping entropy)

planned or intended action. May be due to change in nature of task or change in task environment

correct plan of action. May be due to distraction from task or preoccupation with other things

Murphy's Law

=

DISASTER

We switch to the rule-based level when we notice a need to modify our largely pre-programmed behaviour in line with some change in the situation around us. This problem is often one that we have encountered before and for which we have some pre-packaged solution. It is called rule-based because we apply stored rules of the kind: *if (this situation) then do (these actions)*.

Erroneous judgement in situation not covered by rule. Insufficient knowledge or experience – immaturity. Time/emotional pressures

Subject to routinisation, normalisation and intrinsic hazard

The knowledge-based level is something we come to very reluctantly. Only when we have repeatedly failed to find a solution using known methods, do we resort to the slow, effortful and highly error-prone business of thinking things through on the spot. Given time, we can often produce good solutions but, in an emergency, people are not usually at their best. Our brains behave a bit like a sieve, forgetting some things as we turn our attention from one aspect to another. In addition, we can be plain scared, and fear (like other strong emotions) has a way of replacing reasoned action with 'knee-jerk' or sometimes over-learned responses.

"The study of human error has grown dramatically in the last 20 years. We now know why people make errors and how to prevent 90% of them – but no one seems to care."

- University of Manchester researcher
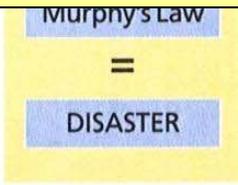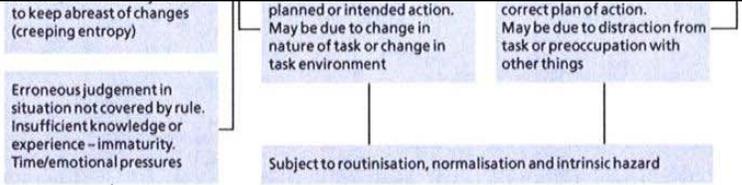
What is the difference?

"Ask me for anything except time, Field Marshall, for it is now lost - and time lost, is lost forever."

Napoleon to Field Marshall Michael Ney

Error Reduction Tool: Manage <u>time</u> – all the time.

Error Reduction Tool: Error patterns
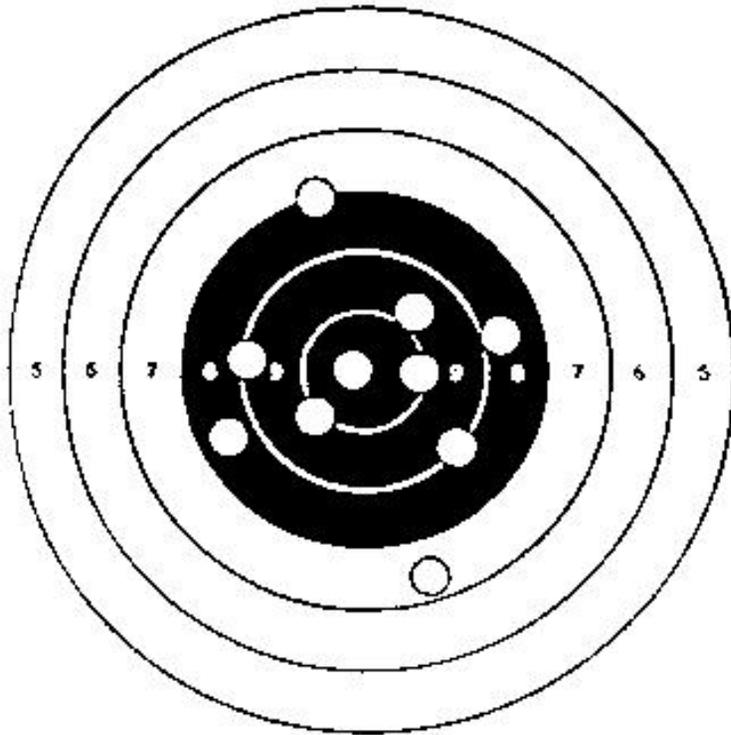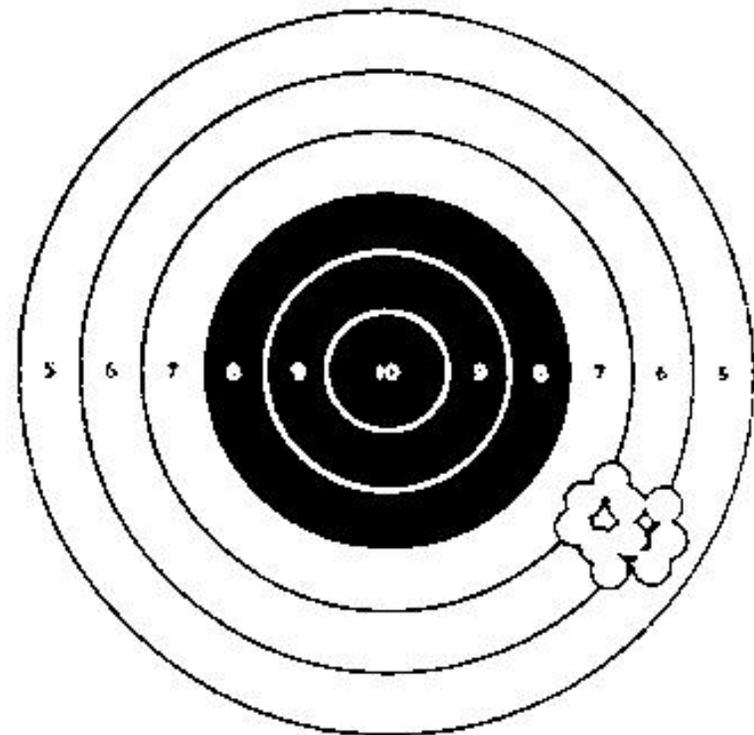
Are You Fit to Test at Peak Performance?

The Mind-Body Link in Personal Error Awareness and Prevention

WHAT CAUSES HUMAN ERROR?
MOST WANTED LIST
(ERROR PRODUCING CONDITIONS)

1. Physiological Degrade (50X)
   - ☑ Fatigue
   - ☑ Nutrition/Hydration
   - ☑ Illness/Medication

2. High Risk/Low Frequency Events (17X)

3. Time Compression (11X)

4. Low Signal to Noise Ratio (10X)

Source: Human Error Assessment and Reduction Technique (HEART)

Dumb has reasons

Fatigue

Acknowledgements

- Captain Nick Davenport, USN

- Mr. Pat Daily, Convergent Knowledge Solutions

- NASA Ames Research Center Z team publications – Mark Rosekind, Elizabeth Co, David Neri, Raymond Oyung, Melissa Mallis, Linda Connell authors and researchers

- Sync – the emerging science of spontaneous order, Steven Strogatz, PhD, MIT

Aeromedical Factors
Cited in Mishaps & Hazards

Number of Events Cited

Value	Factor
121	Spatial Disorientation
106	Fatigue
59	Visual Illusions
35	LOC
28	Heat/Cold/Dehydration
24	Diet/Nutrition
18	Alcohol/Meds/Ills
5	Hypoxia
5	Barotrauma
38	Other

Capt Nick Davenport, USN
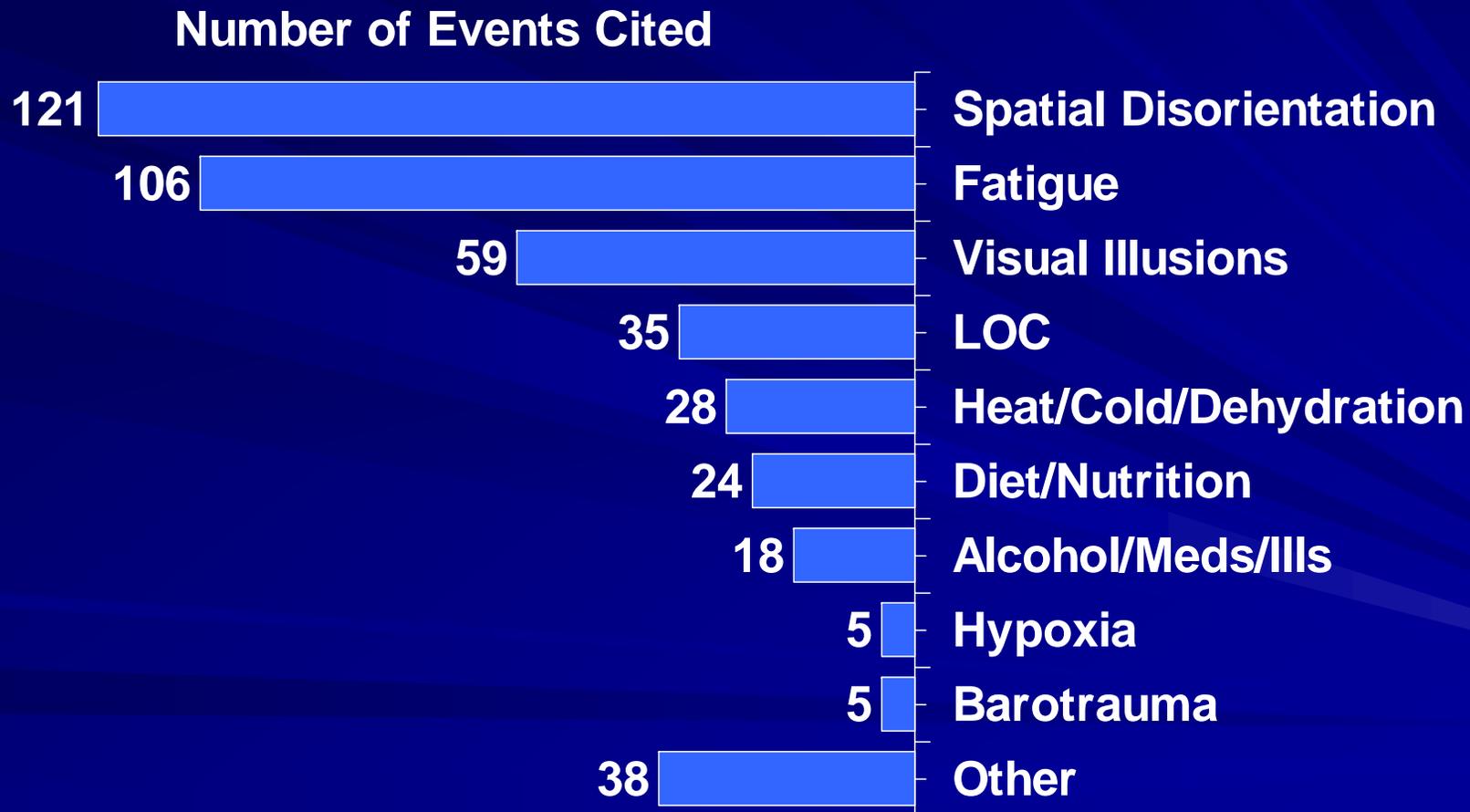
The Science of Fatigue

- The brain is a digital computer:
  - Electro-chemical
  - It cannot run continuously awake
  - It requires scheduled recharge & maintenance intervals

- Fatigue is a physiologic state
  - *Not due to motivation or attitude*

Fatigue in driving[*]

- 100,000 Accidents
- 71,000 injuries
- 1,550 deaths
- $12.5 Billion in monetary losses
- With 6-7 hours sleep risk is doubled versus 8 hours
- With less than 5 hours, the risk is 4-5 times as great.

*National Sleep Foundation (drowsydriving.org)

Figure. Effect of Sleep Deprivation on Psychomotor Performance Compared With Blood Alcohol Concentration
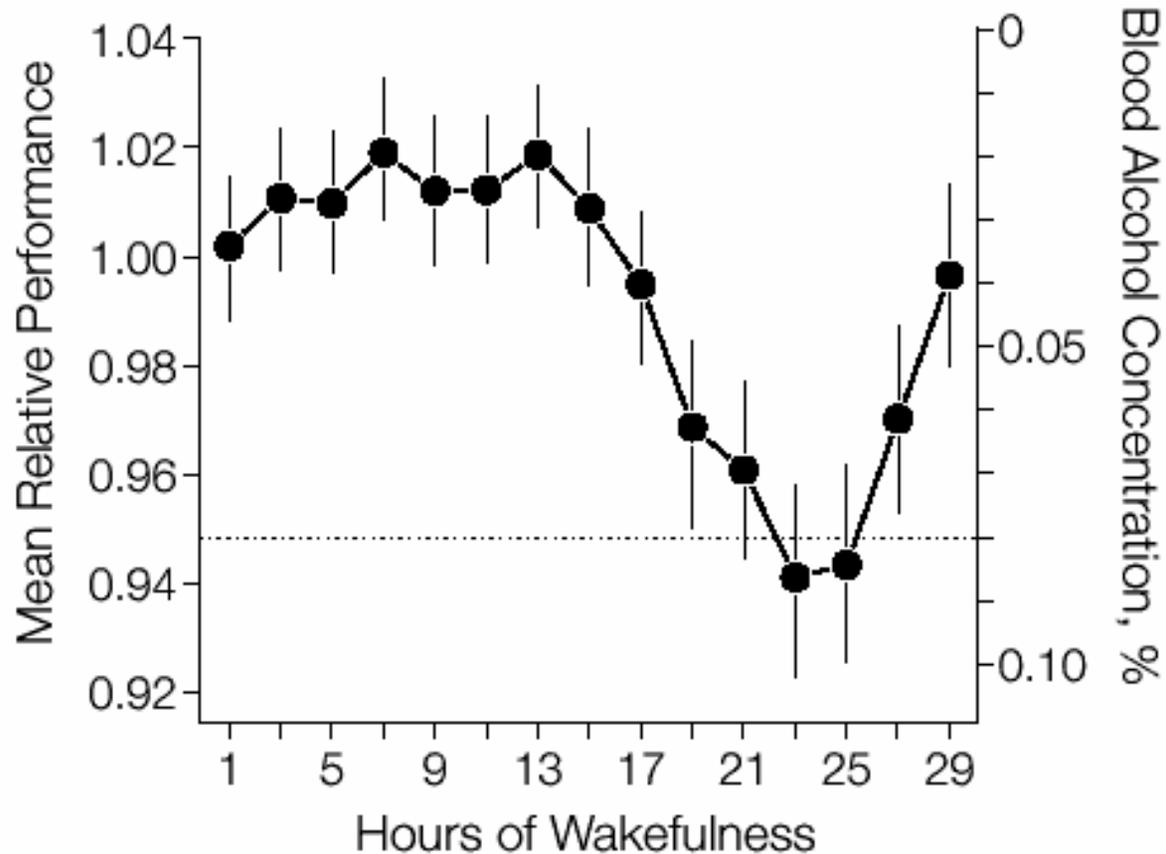
Dawson D, Reid K. Nature 1997; 388: 235.
Fatigue, Alcohol and Performance Impairment
Nature, Volume 388, July-August 1997

The Problem:
Performance Degradation

- Chronic mild sleep deprivation: small increases have increasing effects
- Truck accidents 30-40% by NTSB
- Daylight Savings Time: +8%, -9%
- Challenger, Exxon Valdez, Chernobyl, Three Mile Island, Roosevelt-Leyte Gulf?

How Do We Measure Fatigue?

- We can measure the performance deterioration from fatigue
- We can recognize the signs and symptoms of fatigue
- We can predict where fatigue will develop, based on sleep and work cycles
- But:
  - We have no practical measure for fatigue
  - We can't even reliably estimate our own fatigue level!

WRAIR Sleep Study: Chronic Sleep Restriction
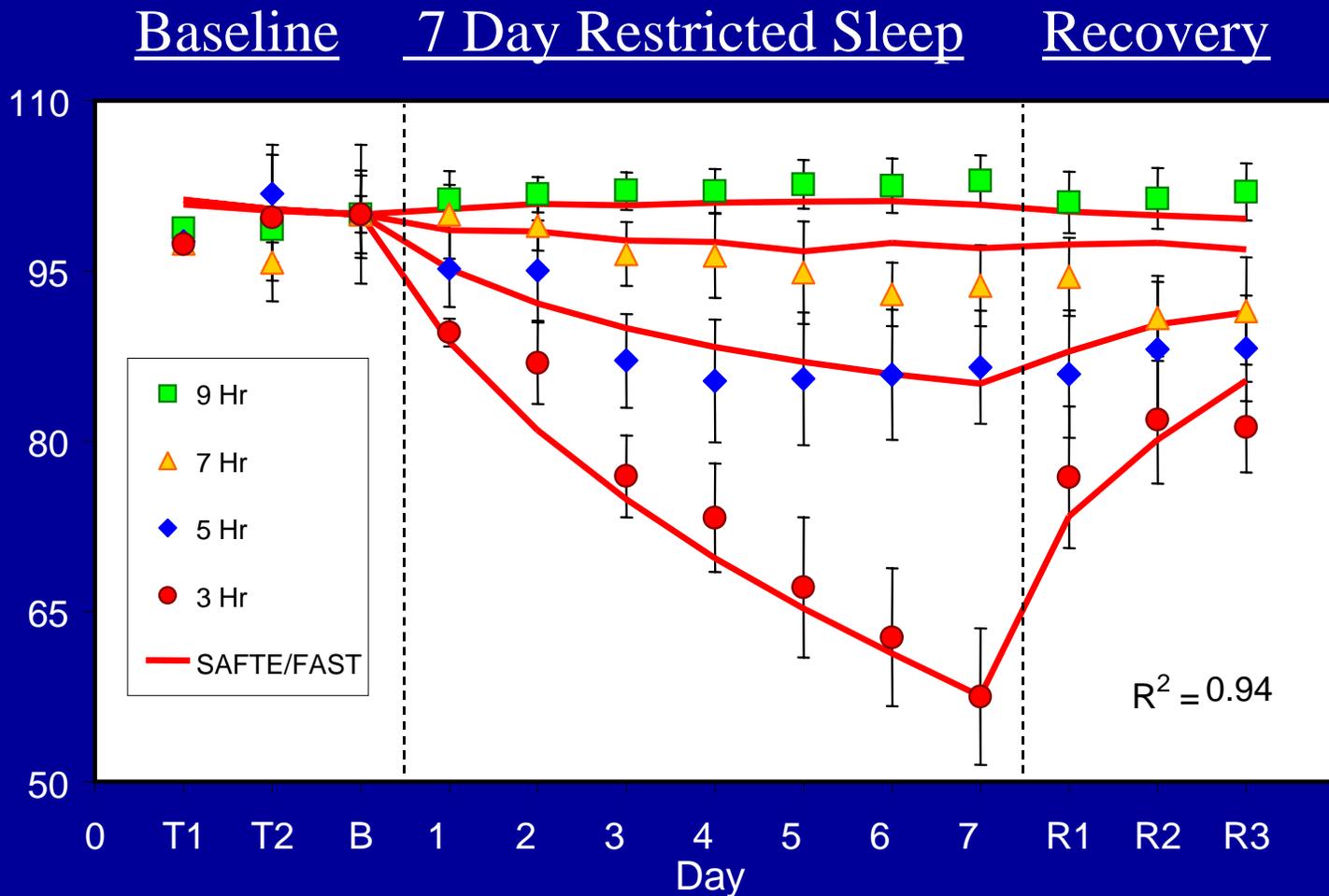
Signs and Symptoms of Fatigue

- Irritability
- Degraded reasoning
- Impaired communication
- Reduced vigilance
- Task fixation

- Increased tolerance for error and risk
- Lethargy
- Forgetfulness
- Delayed reactions
- Microsleeps

Fatigue's Effects are Task-Dependent

- Sense of well-being
- Judgment & decision making
- Vigilance & attention

- Well-learned/simple intellectual or physical tasks

More sensitive to Fatigue

More resistant to Fatigue

Fatigue Predictors

- Best predictors of fatigue:

    1. Sleep debt = (Ideal - Actual) x days
    2. Hours of continuous wakefulness
    3. Circadian rhythm effects
    4. Sleep disorders (sleep apnea, narcolepsy, etc.)

- Self-assessment is poor

Sleep Facts

- Normal amount of sleep 8 - 8 1/4 hours
- Genetically determined
- 6 > sleep > 10 hours: Higher mortality
- Sleep cannot be "banked," but sleep deficits accumulate
- Rest does not replace sleep
- Onset of sleep can be sudden

Sleep Changes with Age

- Amount *and* structure
  - Sleep is less deep
  - More disrupted
  - Less of it
- When away from home, daily sleep loss is 3.5 times greater for those 50-60 vs. those 20-30.

Sleep Impactors

- Medications
  - Idiosyncratic
- Environment (noise, temp, light, critters)
- Booze
- Sleep disorders
- Sleeping pills
- Surface
- Partners
- Family

Circadian Rhythms

- Over 200 circadian rhythms (temp, pulse, immune function, hormones, etc.)
- Entrained by light, period ~24 hours
- Different times to equilibrate
- Week or more to normalize:
  - 1 1/2 hrs phase shift/day west;
  - 1 hr phase shift/day east

Fatigue and Spatial Disorientation

- Vestibular & "seat-of-the-pants" senses conflict with reality
- Spatial Orientation in aviation depends on high-level cognitive power
- Loss of visual cues, task saturation, scan breakdown all lead to SD
- Fatigue aggravates all of these!

Fatigue and Visual Illusions

- Spatial Orientation is 80-85% visual
- Brain takes 2-D images from retinas and interprets 3-D world: requires high-level cognition and computing speed
- Visual illusions result from misperception of reality
- *Fatigue impairs visual interpretation!*

Summary, tools and techniques

- "Sleep" is the set of recharge & maintenance procedures the brain uses to eliminate fatigue
  - Complex activity
  - Scheduled by circadian rhythms
- Based on a 24-hour day
- Fatigue results from:
  - Inadequate *regular* sleep
  - Hours of continual wakefulness
  - Circadian effects

Zeitgebers
(time givers)

- Environmental cues that impact the circadian cycle
- Bright light (full spectrum, 2500 lux)
- Social interactions and habits
  – Mealtimes, showers, alarm clocks
- Odors

Want to sleep more and better?

- Turn off the TV
- Maintain a regular schedule
- Develop and practice a pre-sleep routine
- Use the bedroom only for sleep
  - Avoid work, worry, exercise, non sleep-inducing stimulation
- Avoid excess alcohol

Recommended Fatigue Countermeasures

- Go into high OPTEMPO evolutions well-rested
- Pre-plan; minimize changes
- Schedule with knowledge of circadian effects
- Shift work – how to handle
- Minimize shifts > 12 hours
- Schedule/ encourage naps
- Sleep etiquette
- Diet/meals and feeding
- Exercise and activity
- Who knows when to quit?

NAVMED P-6410

- Comprehensive Guide for Fatigue Management in Operational Settings
- Includes medication use re: stimulants & sedatives
- http://navymedicine.med.navy.mil/instructions/external/6410.pdf

Performance
Maintenance
DURING CONTINUOUS FLIGHT OPERATIONS

• A GUIDE FOR FLIGHT SURGEONS •