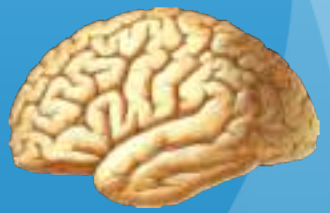
DESCANSO, SUEÑO Y MICROGRAVEDAD

Casa abierta al tiempo

NEUROCIENCIAS



JAVIER VELÁZQUEZ MOCTEZUMA

CLINICA DE TRASTORNOS DEL SUEÑO

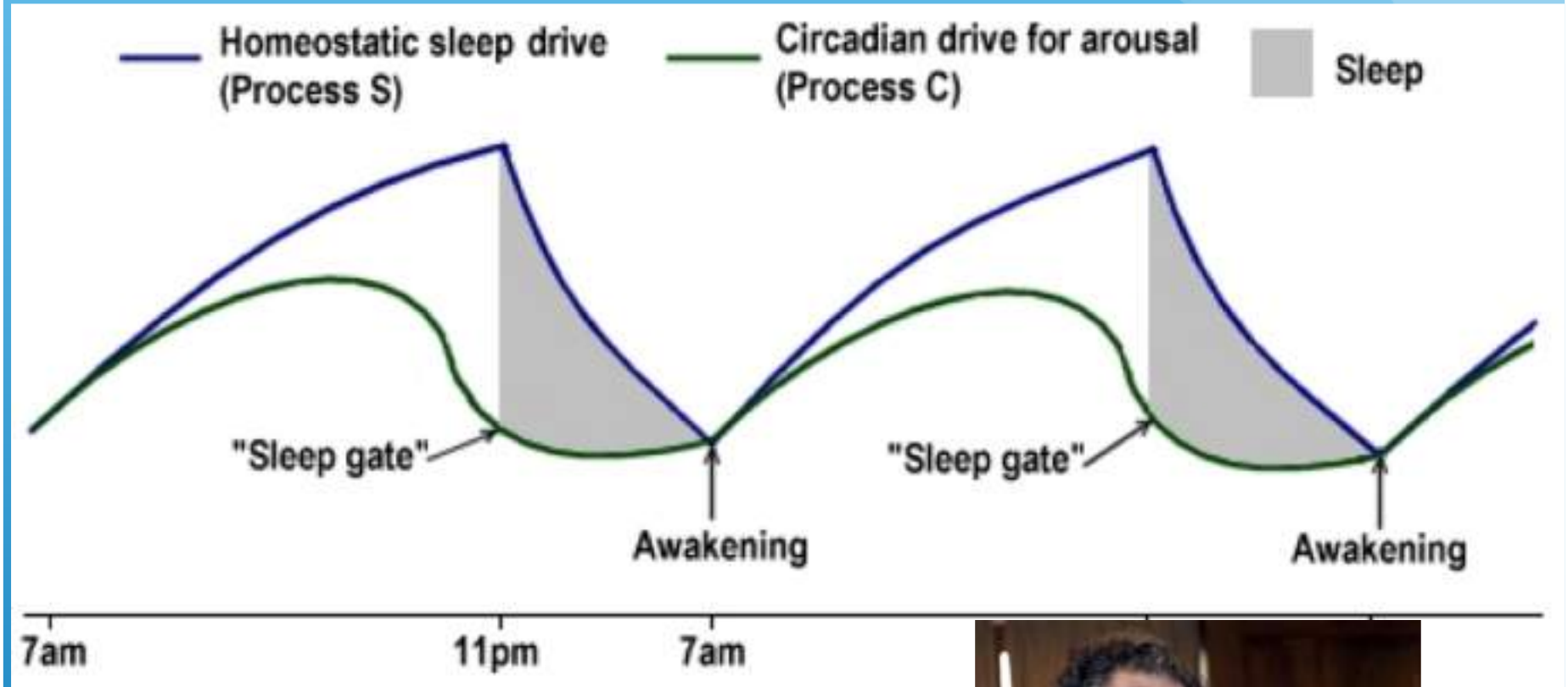
UNIVERSIDAD AUTÓNOMA METROPOLITANA -IZTAPALAPA

LA VIDA SURGE Y EVOLUCIONA EN UN PLANETA CON UN CICLO DE LUZ-OSCURIDAD DE 24 HORAS

CICLO DE ACTIVIDAD-REPOSO
CICLO DE SUEÑO-VIGILIA

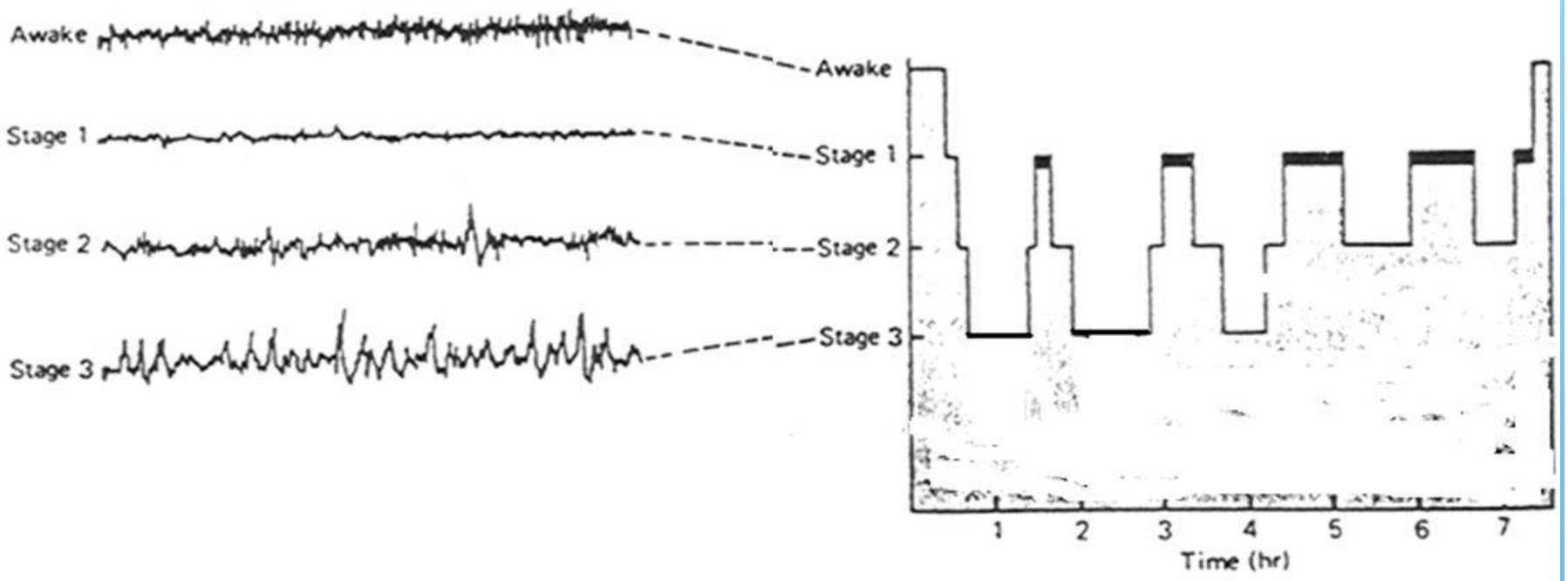
LA VIDA EN UN PLANETA CON LUZ CONSTANTE

LA PRESENTACIÓN DEL SUEÑO DEPENDE DE: LA CANTIDAD DE HORAS DE VIGILIA PREVIAS Y EL MOMENTO DEL CICLO CIRCADIANO

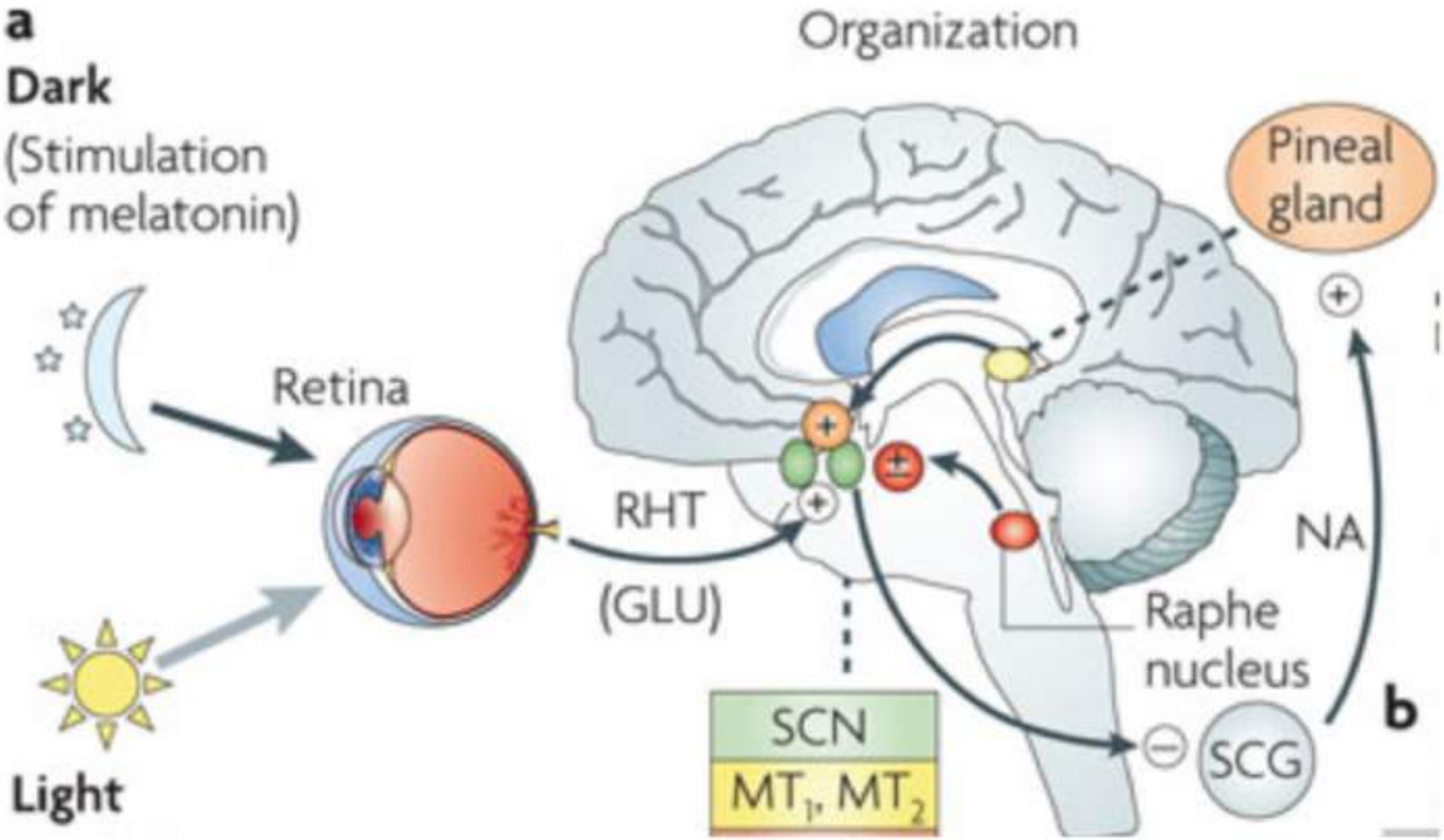


ALEXANDER BORBELY

REPRESENTACIÓN GRÁFICA DE UNA NOCHE



HIPNOGRAMA



Bodinat *et al. Nature Reviews Drug Discovery* (August 2010)

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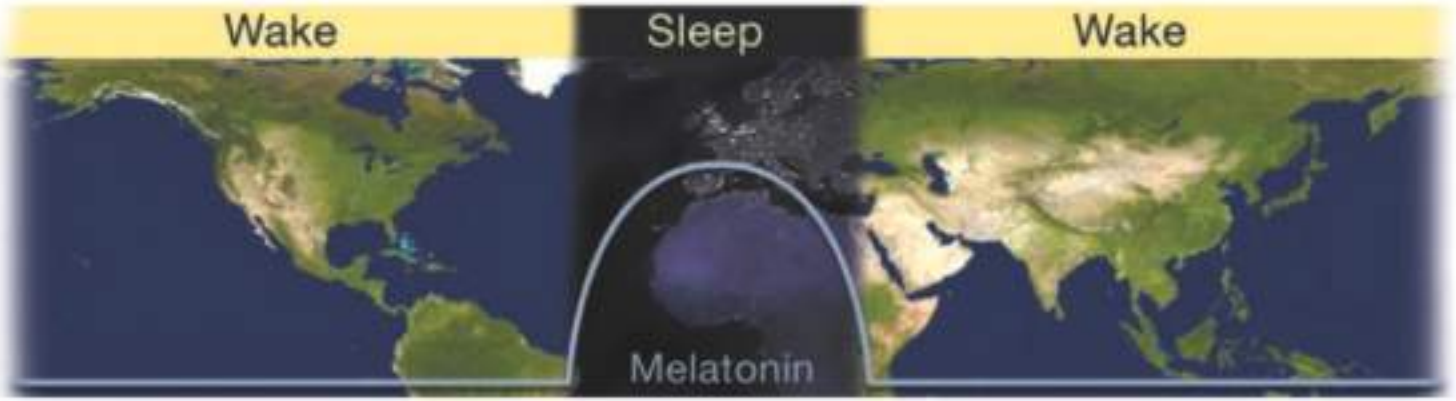
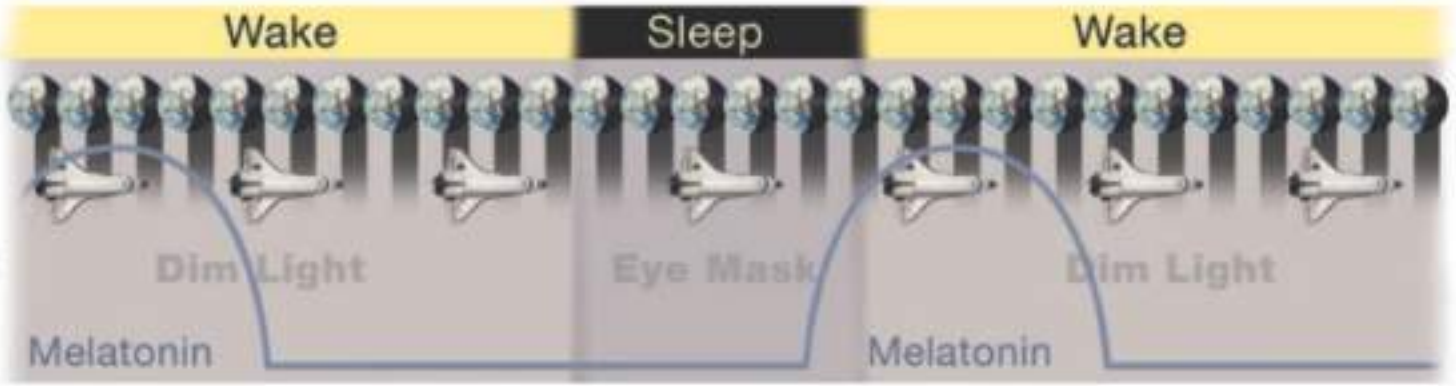
Earth Conditions

On a 24-hour external light/dark cycle, the body's circadian clock remains properly synchronized (e.g., hormones like melatonin are released at the appropriate time).



Space Conditions

On the orbiter's 90-minute light/dark cycle, weak interior ambient light does not sufficiently cue the body's circadian clock, which may then become desynchronized (e.g., inappropriately timed hormone release).



DRAFT 12-22-08

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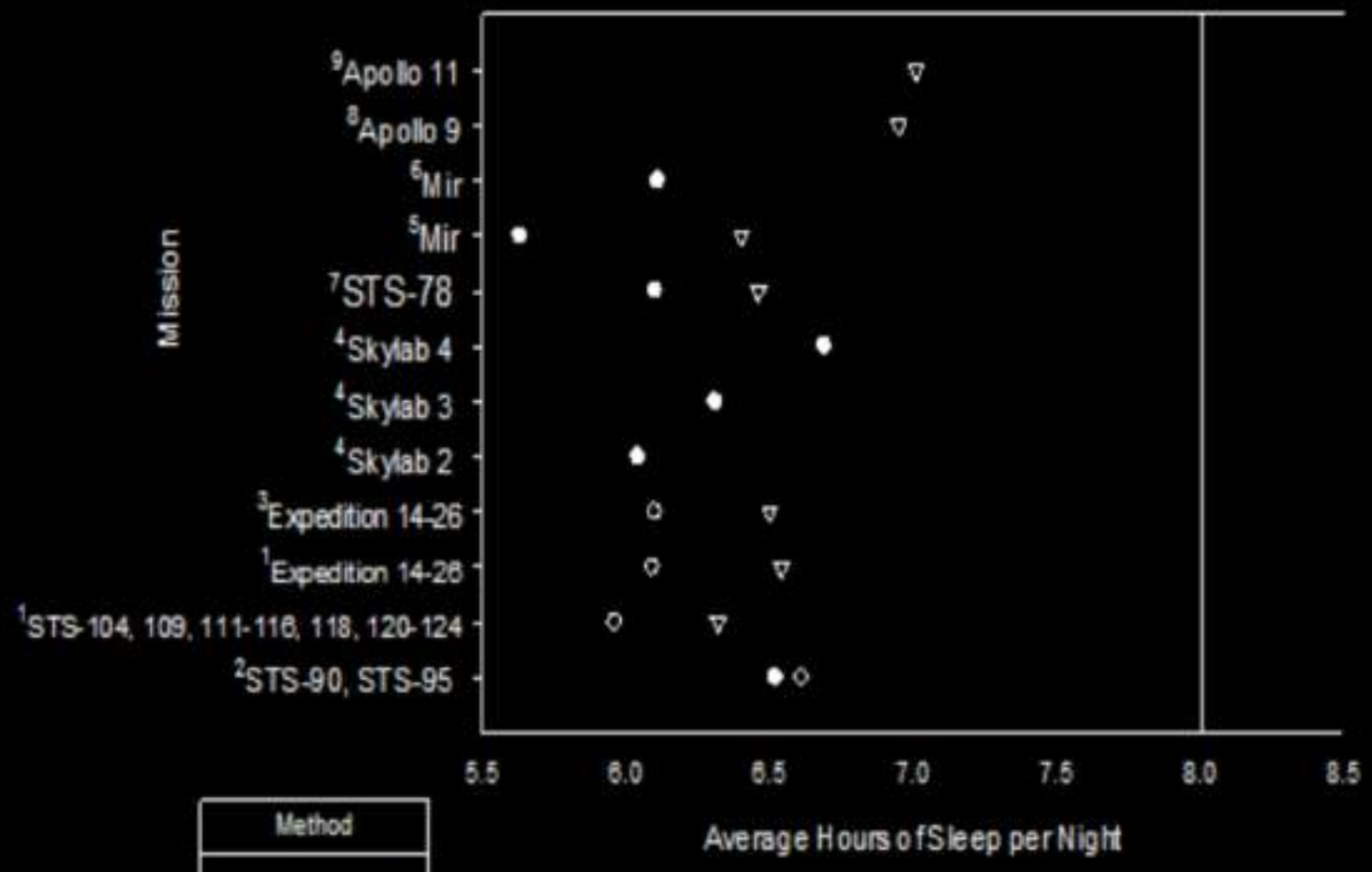
Houston we have a problem!



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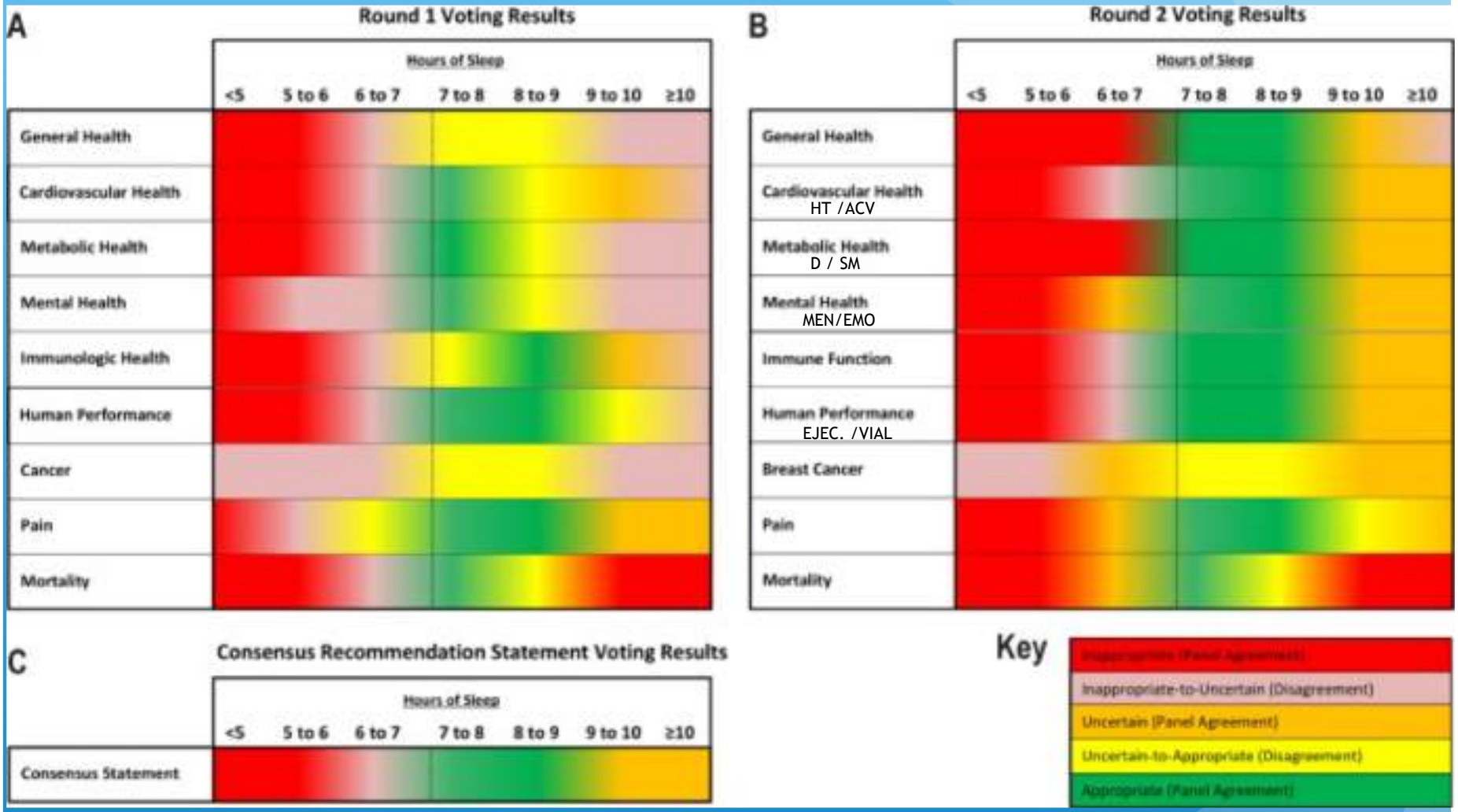
CONSENSO DE LA AMERICAN ACADEMY OF SLEEP MEDICINE Y LA SLEEP RESEARCH SOCIETY 2015



J Clin Sleep Med. 2015 Aug 15; 11(8): 931-952.

Long Hours of Wakefulness Degrades Performance

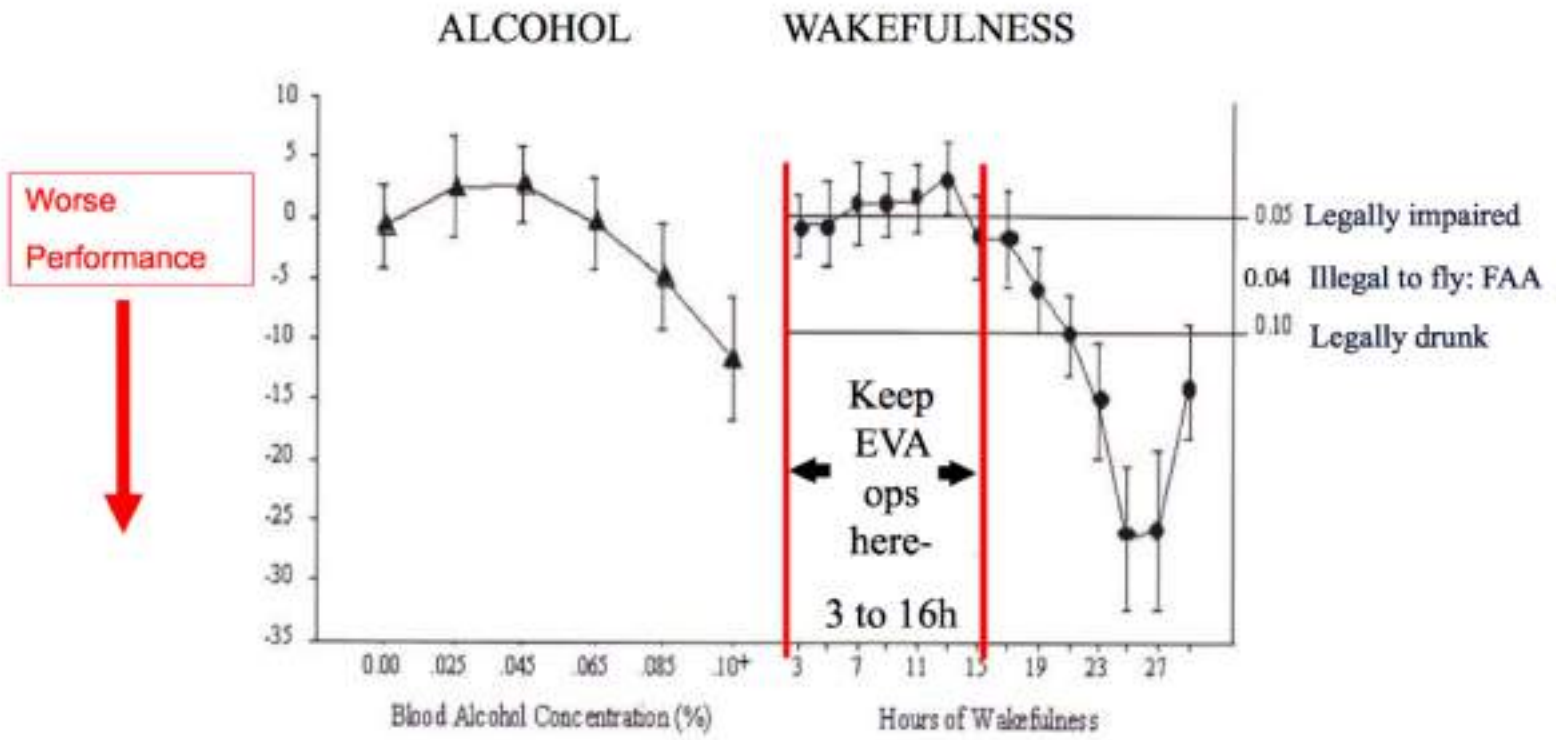
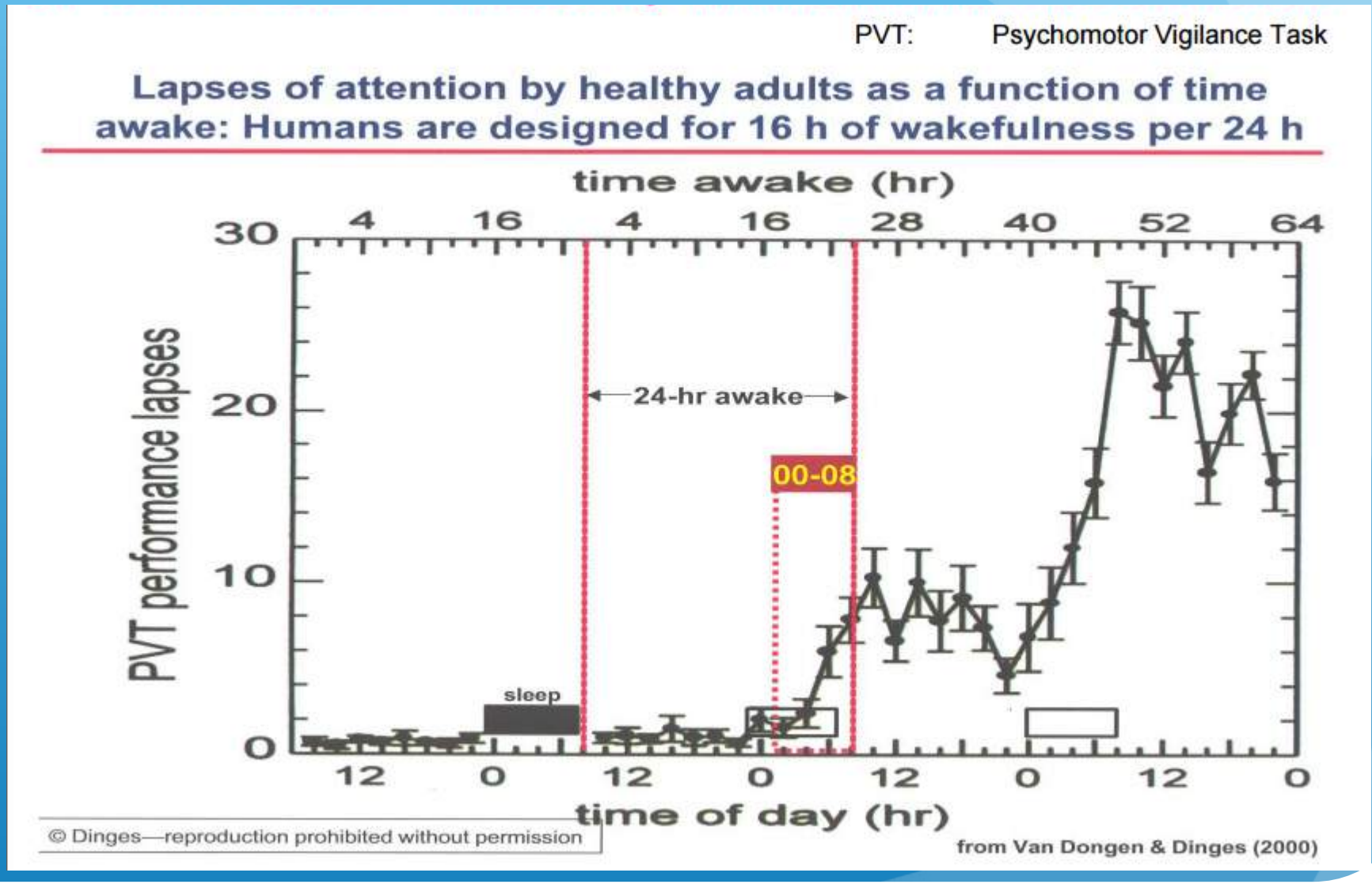


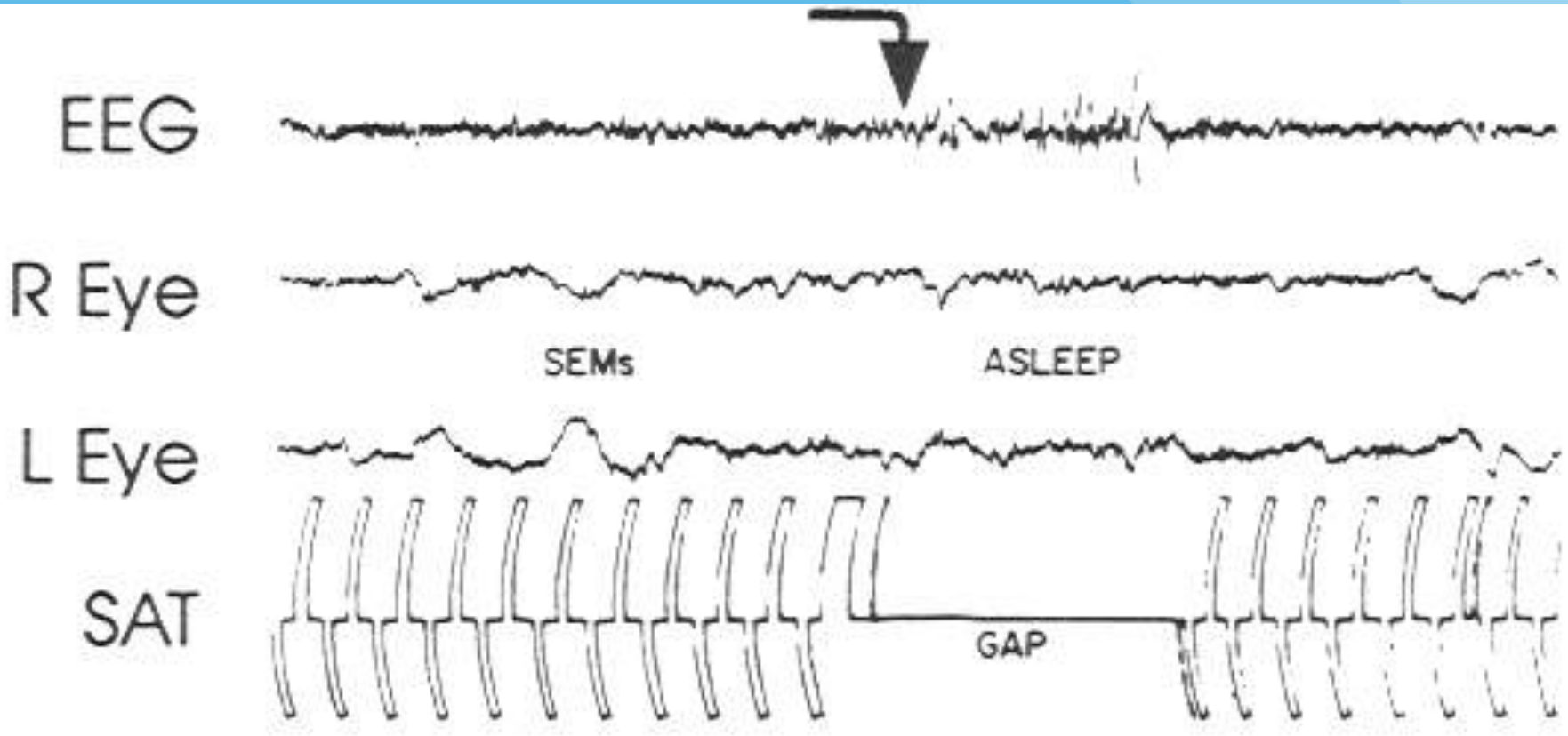
FIG. 1. Mean relative performance levels for the response latency component of the grammatical reasoning task in the alcohol intoxication (left) and sustained wakefulness condition. The equivalent performance decrement at a BAC of 0.05% and 0.10% are indicated on the right hand axis. Error bars indicate ± one s.e.m.

Dawson, D. and Reid, K. Fatigue, alcohol and performance impairment. Nature, 388: 235, 1997

LOS HUMANOS ESTÁN DISEÑADOS PARA FUNCIONAR BIEN CON 16 HORAS DESPIERTO Y 8 HORAS DORMIDO.



LA PRESENCIA DE ONDAS LENTAS EN EL EEG DETERMINA LA SUSPENSIÓN DE ACTIVIDADES VOLUNTARIAS



The failure to perform a simple behavioral task at the onset of sleep. The volunteer was required to tap two switches alternately, shown as pen deflections of opposite polarity on the channel labeled SAT. When the EEG pattern changes to Stage 1 sleep (arrow), the behavior stops for the period indicated by the word "gap," returning when the EEG pattern reverts to wakefulness. (SEMs=slow eye movement)

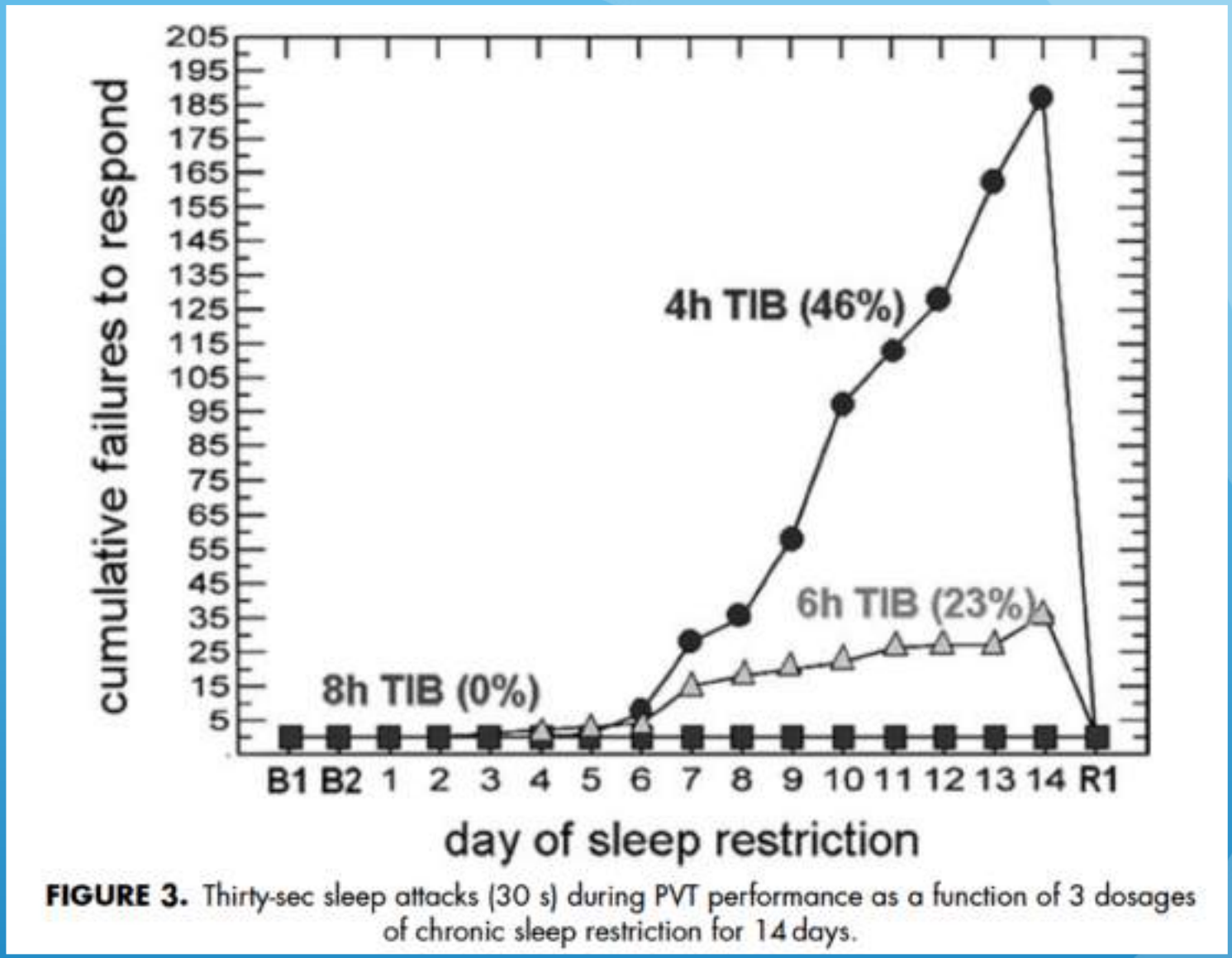


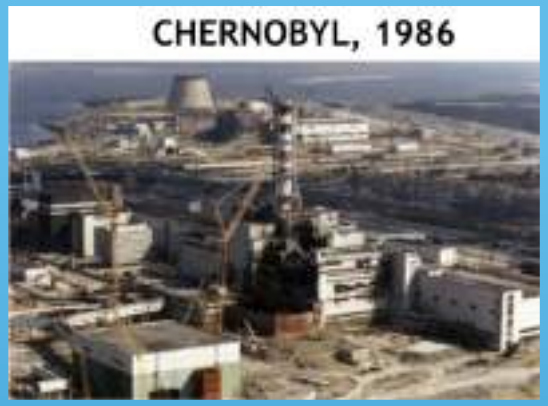
FIGURE 3. Thirty-sec sleep attacks (30 s) during PVT performance as a function of 3 dosages of chronic sleep restriction for 14 days.

Lim J. Dinges D. NY ACAD Sci 2008

ALGUNOS EFECTOS DE LA VIGILIA PROLONGADA Y LA PÉRDIDA DE SUEÑO EN HUMANOS

- MICROSUEÑOS INVOLUNTARIOS
- AUMENTO DE ERRORES POR OMISIÓN O POR COMISIÓN
- MEMORIA DE TRABAJO DECLINA Y SUS FUNCIONES EJECUTIVAS
- LENTIFICACIÓN DE RESPUESTAS PSICOMOTORAS
- AUMENTO DEL ESFUERZO POR MANTENERSE FUNCIONALMENTE ADECUADO
- INCREMENTO DE LA TENDENCIA A INVOLUCRARSE EN CONDUCTAS DE RIESGO
- DETERIORO DE LA AUTOPERCEPCION SUBJETIVA DE DETERIORO

Goel N. Et al. Neurocognitive Consequences of Sleep Deprivation. Semin Neurol 29(4): 320–339. 2009.



ALGUNAS CATÁSTROFES DEBIDAS A PROBLEMAS DE SUEÑO

https://ntrs.nasa.gov/search.jsp?R=20150009487 2018-06-20T20:36:05+00:00Z

The New York Times

Astronaut Error Adds New Anxiety on Space Station

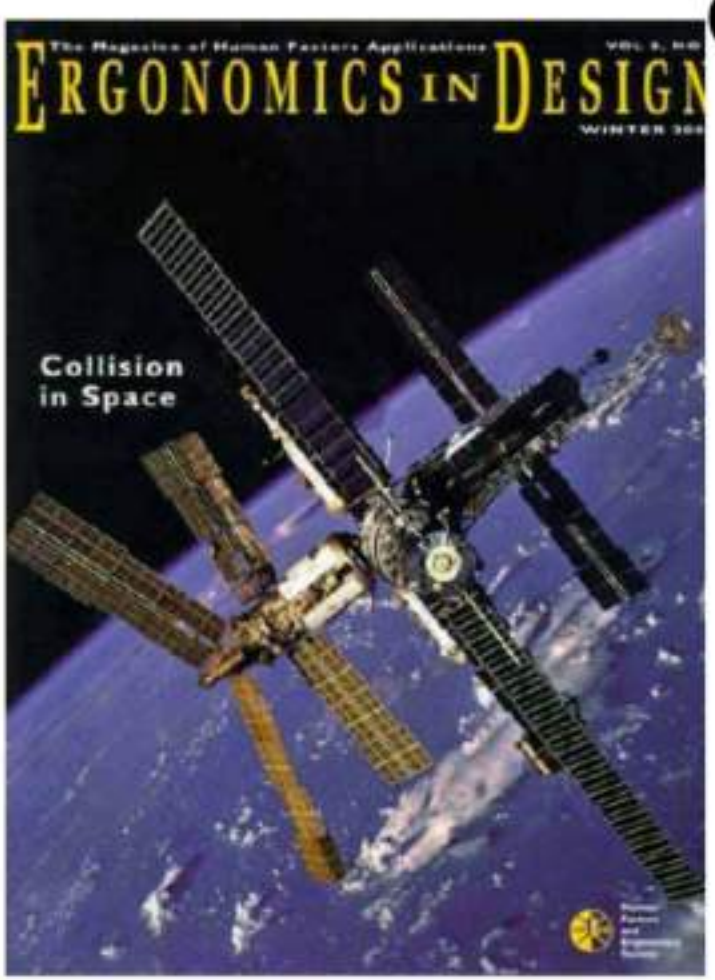
July 18, 1997

By MICHAEL R. GORDON

MOSCOW -- An astronaut aboard the Mir mistakenly disconnected a critical cable on Thursday, disabling the guidance system that enables the space station to gather solar energy and causing yet another crisis for the trouble-plagued craft...

The repair mission will also be delayed because the crew has been instructed to take several days off and get more rest. That is an implicit recognition that fatigue is believed to have played a role in the mistake on Thursday. The Russian crew members were reported to have had a sleepless night.

"This was purely human error," [Mission Director Vladimir] Solovyov said.



Collision in Space

Human factors such as inadequate visual displays and operator fatigue played significant roles in the collision of Space Station *Mir* and *Progress 234*.

BY STEPHEN R. ELLIS

On June 25, 1997, the Russian supply spacecraft *Progress 234* collided with the *Mir* space station, rupturing *Mir*'s pressure hull, throwing it into an uncontrolled attitude drift, and nearly forcing evacuation of the station. Like many high-profile accidents, this collision was the consequence of a chain of events leading to the final piloting errors that were its immediate cause.

The discussion in this article does not resolve the relative contributions of the actions and decisions in this chain. Neither does it suggest corrective measures, many of which are straightforward and have already been implemented by the National Aeronautics and Space Administration (NASA) and the Russian Space Agency. Rather, its purpose is to identify the human factors that played a pervasive role in the incident. Workplace stress, fatigue, and sleep deprivation were identified by NASA as contributory factors in the *Mir-Progress* collision (Culbertson, 1997; NASA, forthcoming), but other contributing factors, such as requiring crew to perform difficult tasks for which their training is not current, could potentially become important factors in future situations.

The *Mir* Programs and Crew

In 1995, NASA began sending astronauts to the Russian *Mir* space station as Phase 1 of an international program to learn to live and work in space, the International Space Station. NASA expected to benefit from unique Russian experience in very long duration space flight, use *Mir* to test and verify new technology, conduct scientific research requiring microgravity environments, and help keep the Russian space program afloat through an infusion of more than $400 million, support personnel, and the use of the space shuttle for supply. In particular, NASA hoped cooperating with the Russians would reduce the risks of long-duration space flight and eventual interplanetary missions. Initial research would be directed toward biological and materials science research requiring long-term exposure to a space station microgravity environment (Culbertson, 1997; Oberg, 1998).

Three crew members were on board *Mir* at the time of the collision (pictured in the photo on page 5). Vasili Tsibliyev, a former military jet pilot and *Mir* commander, received his pilot training at the Grimovets Military School of Aviation and the Gagarin Air Force Academy between 1973 and 1987. He then followed a general space training course at the Gagarin Cosmonaut Training Center between 1987 and 1989. He had previous

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Alterations in sleep and resultant performance decrements in spaceflight

https://ntrs.nasa.gov/search.jsp?R=20150009487 2018-06-20T20:36:05+00:00Z

Operational impacts of chronic fatigue in space

- The term "space fog" has been used by astronauts to describe a phenomenon of
  - Forgetfulness
  - slowed reaction time
  - transient confusion while trying to complete tasks
- Space Fog is not a loss of cognitive ability
  - It is a loss of the usual environmental stimuli that reinforce memory

Why Can't Astronauts Sleep?

- Circadian rhythm/scheduling factors?
- High workload leading to acute or chronic sleep loss?
- Environmental Disruption?
- Excitement?
- Microgravity?

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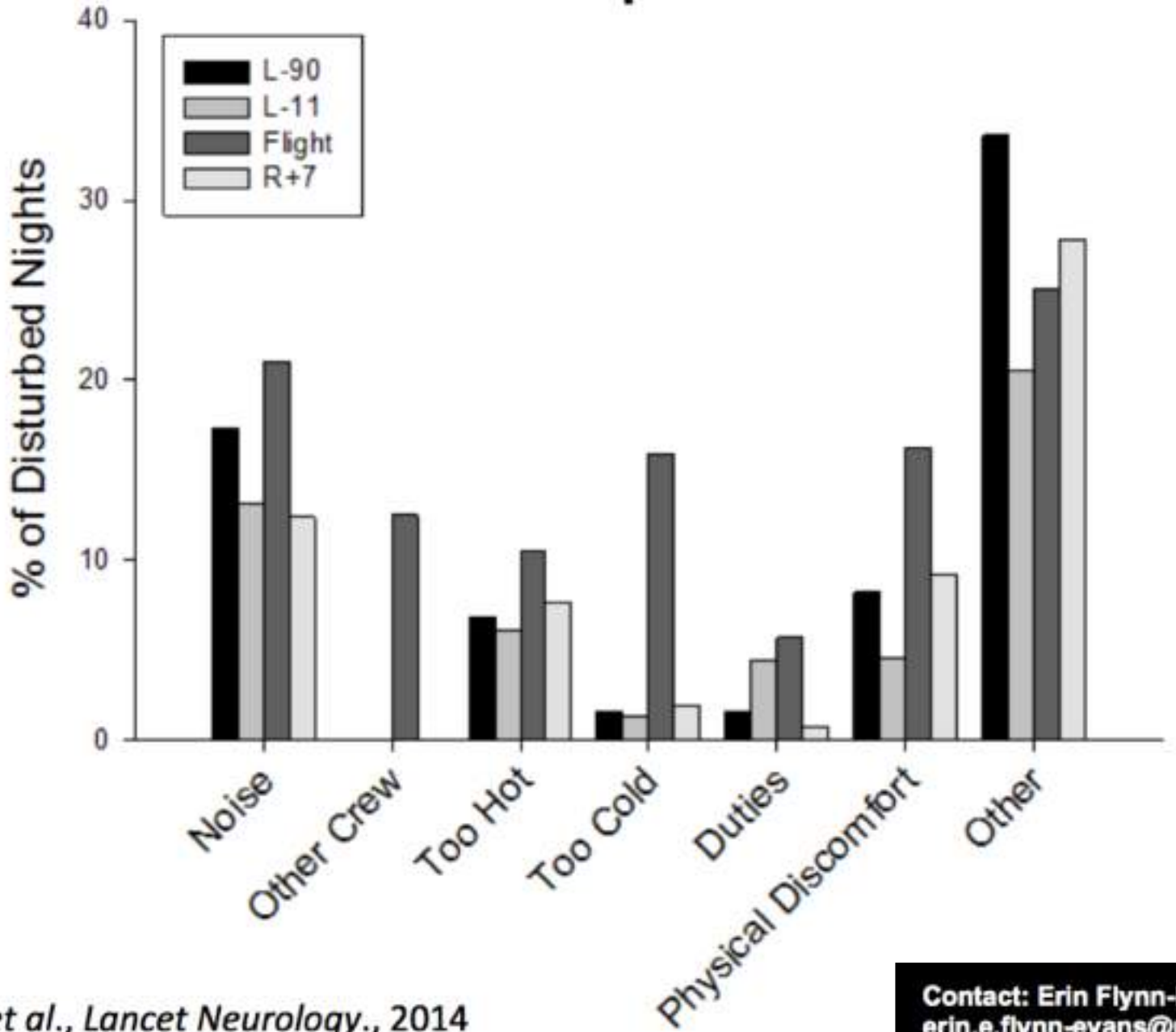
Causes of Sleep Disturbance



Barger *et al.*, *Lancet Neurology.*, 2014

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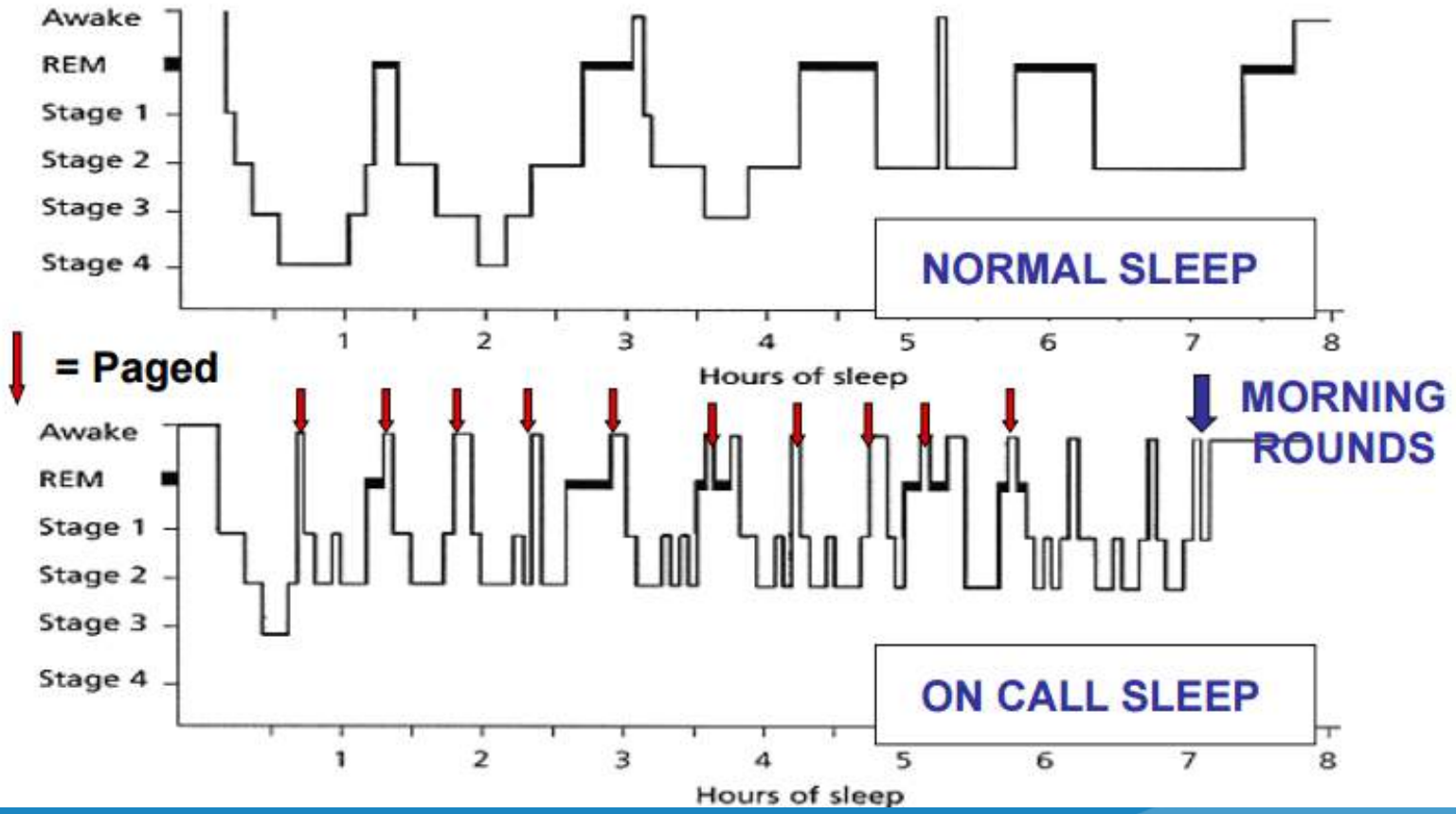
Sleep Fragmentation Affects Sleep Quality



FATIGUE IN U.S. ASTRONAUTS ONBOARD THE INTERNATIONAL SPACE STATION: ENVIRONMENTAL FACTORS, OPERATIONAL IMPACTS, AND IMPLEMENTATION OF COUNTERMEASURES

R.A. Scheuring, R.C. Moomaw, S.L. Johnston

IDENTIFICACIÓN DE FACTORES DE FATIGA PARA GENERAR MEDIDAS DE MITIGACIÓN

Background

- Crewmembers have experienced fatigue for reasons similar to military deployments. Astronauts experience psychological stressors such as
  - heavy workloads
  - extended duty periods
  - circadian misalignment
  - inadequate/ineffective sleep
  - distracting background noise
  - unexpected and variable mission schedules
  - unfavorable thermal control
  - unusual sleep environment with schedules that impinge on pre-sleep periods

LA MICROGRAVEDAD PUEDE SER UNA CAUSA DE FATIGA

Etiology of chronic fatigue in space

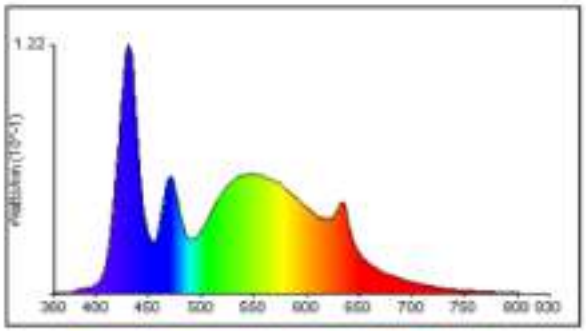
- Interestingly, the chronic fatigue astronauts report early on in their 6-month mission may be secondary to transitioning from a planar environment to a 360° microgravity perspective

LAS MEDIDAS DE MITIGACIÓN PUEDEN SER EFECTIVAS

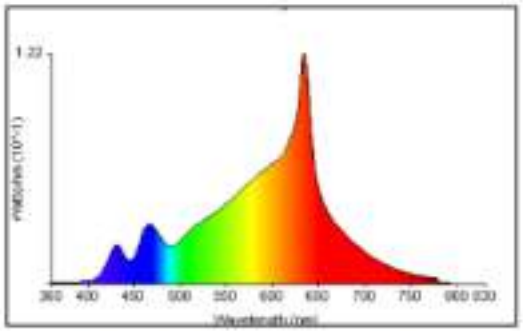
- These countermeasures to improve sleep duration and quality in astronauts on the ISS have been instituted with moderate degrees of success as measured by self-reaction time (psychomotor vigilance task testing), actigraphy, and subjective reports.

Countermeasures

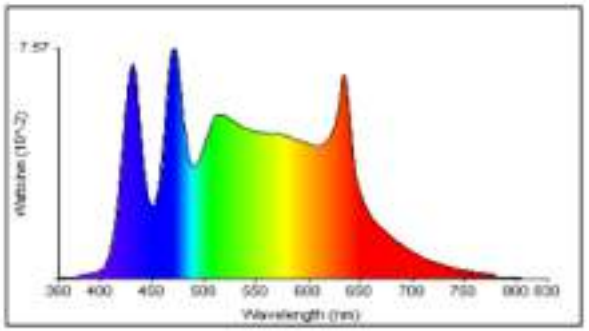
Replacement Lights ISS



Brightness: 1500 lux
Color: 6500K + emphasize blue deemphasize red



Brightness: 50-100 lux
Color: 2700K deemphasize blue emphasize red



Brightness: 300-500 lux
Color: 4100K full spectrum

Countermeasures

- Judicious use of stimulants and hypnotics, light therapy, controlled sleep periods, sleep shifting for visiting vehicle operations or EVA, and reducing ambient CO2 levels are a few of the most promising countermeasures being used in space to improve sleep and reduce fatigue.

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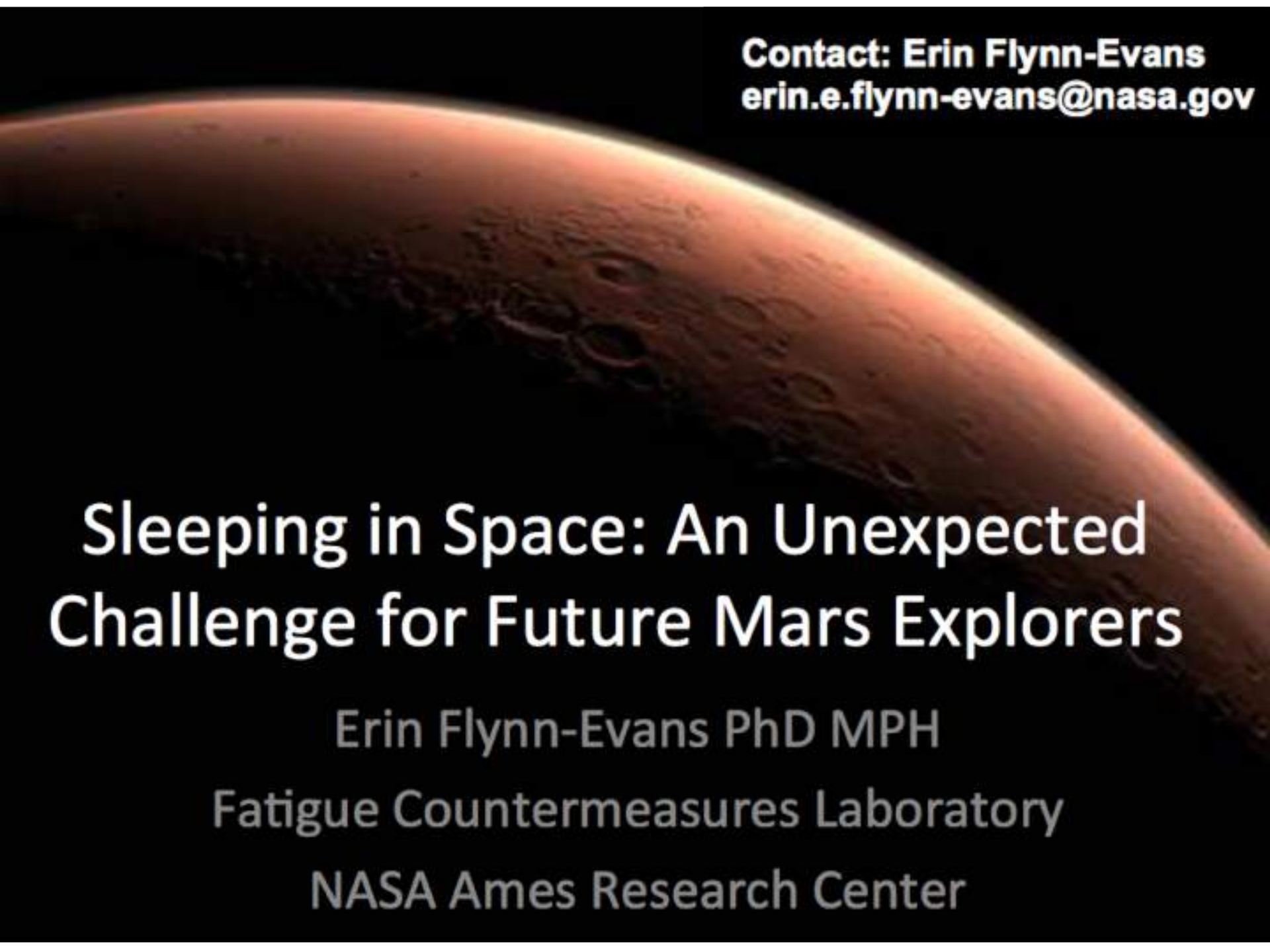


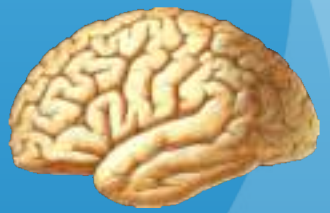
Sleeping in Space: An Unexpected Challenge for Future Mars Explorers

Erin Flynn-Evans PhD MPH
Fatigue Countermeasures Laboratory
NASA Ames Research Center

DESCANSO, SUEÑO Y MICROGRAVEDAD

Casa abierta al tiempo

NEUROCIENCIAS



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