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RAGGED

Everybody is a Ragged University

What has Psychology ever done for us?

4. To sleep, perchance to dream:
30 years in the land of Morpheus

Prof. Ray Miller

Greek Letter Psi

The Programme

- ***Part 1:*** ***All in the Mind: Understanding me, you and the world around us.*** ***(February)***

  Consciousness, perception, memory, personality and socialisation.

- ***Part 2:*** ***Barefoot in the Head: How the way we think, feel and behave produces mental and physical health.*** ***(April)***

  Psychological therapies from the couch, through dogs and rats, to mindfulness and positive thinking.

- ***Part 3:*** ***We don't need no Educashun: The brain as a learning machine.*** ***(June)***

  How learning develops, intelligence, critical thinking and the do's and don'ts of study skills.

- ***Part 4:*** ***To sleep, perchance to dream: 30 years of slumber.***

  Why do we sleep? How much do we need? What happens in sleep? What are dreams?.

Tonight

With apologies for all that had to be left out!

- What do we *REALLY* know about sleep?
- Ten common myths about sleep.
- Sleep in plants and animals – and some oddities.
- The sleep cycle in humans.
- Why do we sleep? Three theories.
- Common sleep disorders.
- Getting a good sleep.
- What are dreams and why dream? Three theories.
- Lucid dreaming and sleep paralysis.

Sleep and Dreams

"Even a soul submerged in sleep is hard at work and helps make something of the world."
— Heraclitus —

Alarm Call

"Some people talk in their sleep. Lecturers talk while other people sleep"

Albert Camus

Sleep and dreams?

The Obvious?

- We all need and experience sleep
- We sleep over a third of our lives
- We devote a third of our houses to sleep
- We all dream (we don't always remember)
- Sleep is the stuff of myth and literature
- Sleep has only recently been the subject of scientific study (use of EEG and brain imaging)
- We understand surprisingly little about sleep

Some sleep myths

MYTH 1: SLEEP IS A PASSIVE ACTIVITY

- Most of us think about sleep as just down-time, a period of rest when we shut down to conserve energy. It may appear on the surface to be an absence of consciousness, but sleep is an active state within the brain. A complex sequence of events, which follows a regular, cyclical pattern every night.

MYTH 2: EVERYONE NEEDS 8 HOURS SLEEP A NIGHT

- Scientific studies over the years have proven that we're not all the same when it come to the amount of sleep we need in order to function optimally the next day. Sleep requirements also vary over our lifespan, 16 hours is normal for a new-born, whilst adolescents generally need 8-10 hours and adults average 7-8 hours.

Some sleep myths

MYTH 3: COUNTING SHEEP HELPS YOU FALL ASLEEP

- It's an old theory that imagining sheep and counting them one by one will help to lull you to sleep. Oxford University Psychologists found the opposite could be true. Volunteers who pictured counting sheep took up to **20 minutes longer** to fall asleep than those who imagined other scenarios such as a relaxing beach.

MYTH 4: DRINKING ALCOHOL WILL GIVE YOU A BETTER NIGHT'S SLEEP

- Alcohol has a natural sedative effect so it may seem logical that a glass of wine, a whisky or a beer before bed would help you get a good night's rest. Whilst it might help you fall asleep quicker, as the alcohol is metabolised through your body during the night, your sleep becomes progressively lighter and the likelihood of wakefulness actually increases (and need to visit toilet!).

Some sleep myths

MYTH 5: A WARM GLASS OF MILK BEFORE BED

- Some people believe a glass of warm milk helps you fall asleep because it contains tryptophan, an essential amino acid responsible for producing serotonin, which is vital for healthy sleep. A glass of milk on it's own will not produce these effects. You body also needs carbohydrate-rich foods which help produce insulin. This is essential for tryptophan to have any sleep inducing effects.

MYTH 6: CATCH UP ON YOUR SLEEP AT WEEKENDS

- If you've had a busy week of work or social engagements you may have incurred some 'sleep debt'. A common belief is that you can catch up hours you missed during the week by sleeping a few extra hours at the weekend. Studies have shown that this may not be adequate to fully restore you for the week ahead.

Some sleep myths

MYTH 7: SLEEP DEPRIVED CHILDREN WILL BE DROWSY AT SCHOOL

- With sleep deprivation, adults and children behave in different ways. Adults become drowsy and less active. Many children have an opposite reaction. Sleep deprived children tend to overcompensate for tiredness and exhibit signs of hyper-activity, inattentiveness and impulsive behaviour. These may be misdiagnosed as attention deficit hyper-activity disorder (ADHD).

MYTH 8: DREAMING ONLY HAPPENS DURING REM SLEEP

- REM (rapid eye movement) is one of five stages of sleep. It was observed that patients awoken during the REM phase recalled their dreams most vividly. REM has thus been associated with dreaming but, although REM dreams tend to be longer, more complex and bizarre, dreaming occurs independently throughout non-REM sleep.

Some sleep myths

MYTH 9: TEENAGERS ARE LAZY AND LOVE LYING IN BED

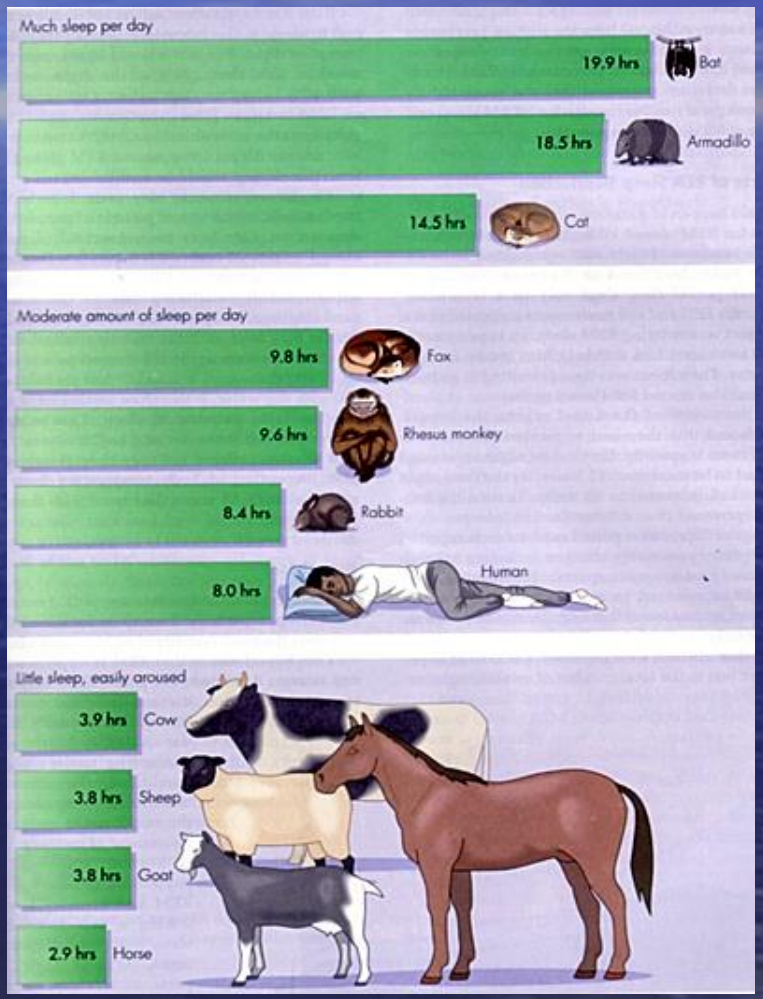
- A common assumption is that teenagers are lazy, moody and unmotivated getting out of bed in the morning. Research shows real biological factors explain these types of behaviour. During puberty, a 2-3 hours delay occurs in the circadian rhythms and children of this age, particularly males, gradually become more 'evening types'.

MYTH 10: EARLY TO BED, EARLY TO RISE, MAKES A MAN HEALTHY, WEALTHY AND WISE

- A quote from Benjamin Franklin. Aristotle was also a fan of early morning productivity. But studies have shown no noticeable difference in mental performance when 'larks' and 'owls' were tested in the morning. While, in the evening, larks performed noticeably worse at most tasks compared to their owl counterparts.

Ubiquitous sleep?

- Most organisms have a sleep cycle
- Even plants have circadian rhythms
- Animals share many similarities
  - Retreat to sleeping site and sleeping body posture
  - Sleep rituals
  - Cessation of physical activity
  - Reduction in behavioural responsiveness
  - Circadian regulation
  - Sleep rebound



Sleep oddities

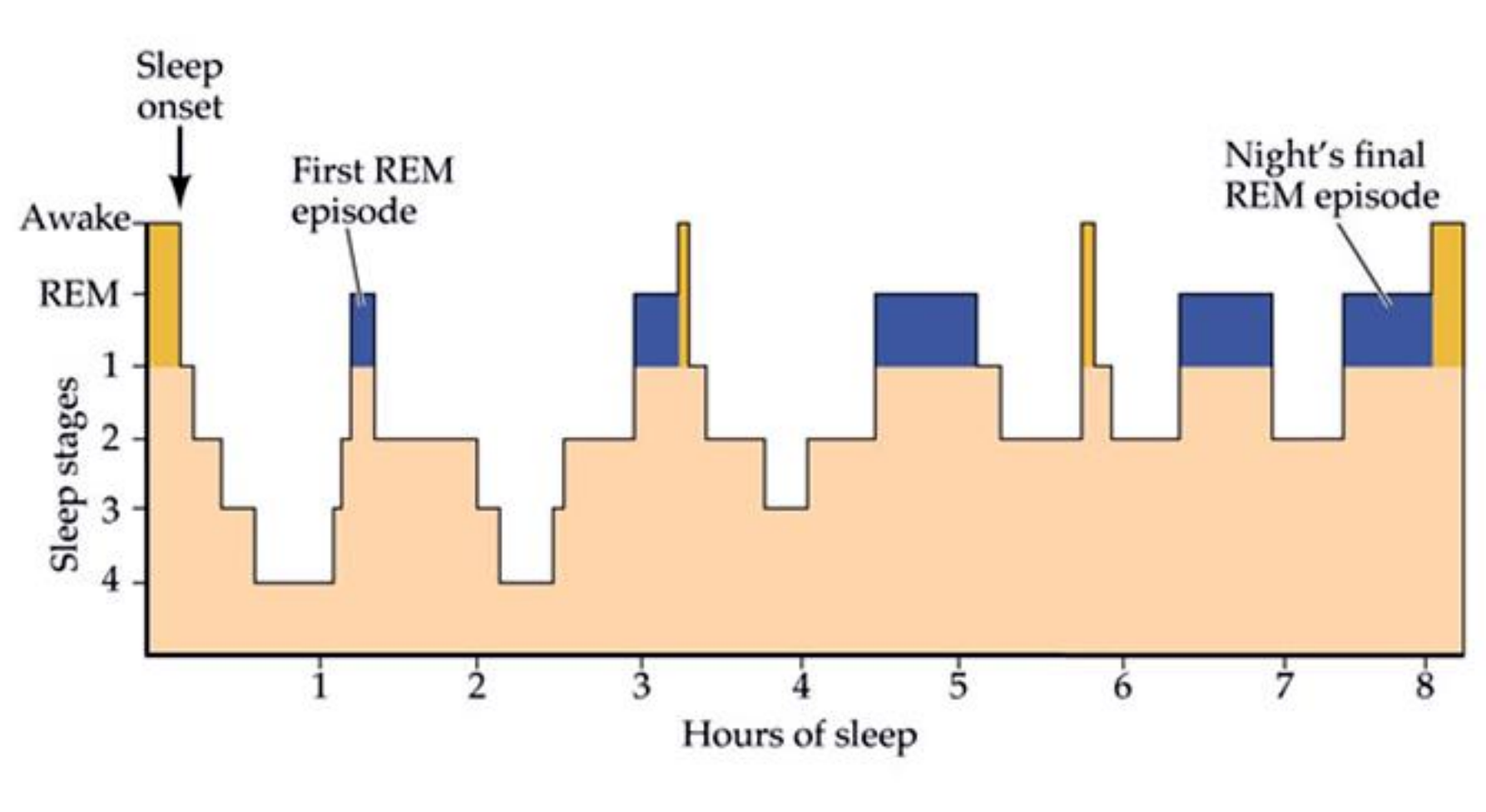
- Seals sleep like most mammals when on land but with only half their brain at a time when at sea

- Dolphins and whales only ever sleep with half their brain at a time

Stages of Sleep

- Sleep stage 1 - brief transition stage when first falling asleep
- Stages 2 through 4 (slow-wave sleep) - successively deeper stages characterized by an increasing percentage of slow, irregular, high-amplitude delta waves
- On reaching stage 4, after about 80 to 100 minutes of total sleep time, sleep lightens and returns through stages 3 and 2
- REM sleep emerges, characterized by EEG patterns that resemble beta waves of alert wakefulness
  - muscles most relaxed
  - rapid eye movements occur
  - most dreaming occurs
- Four or five sleep cycles occur in a typical night - less time is spent in slow-wave, more is spent in REM as the night progresses

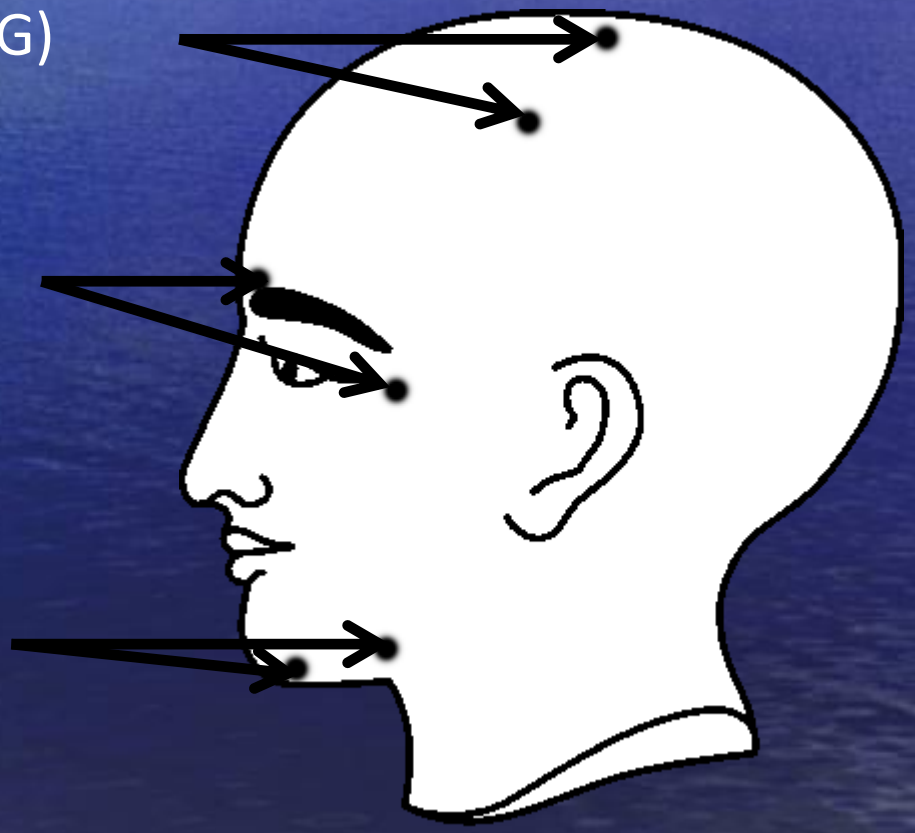
Human sleep stages



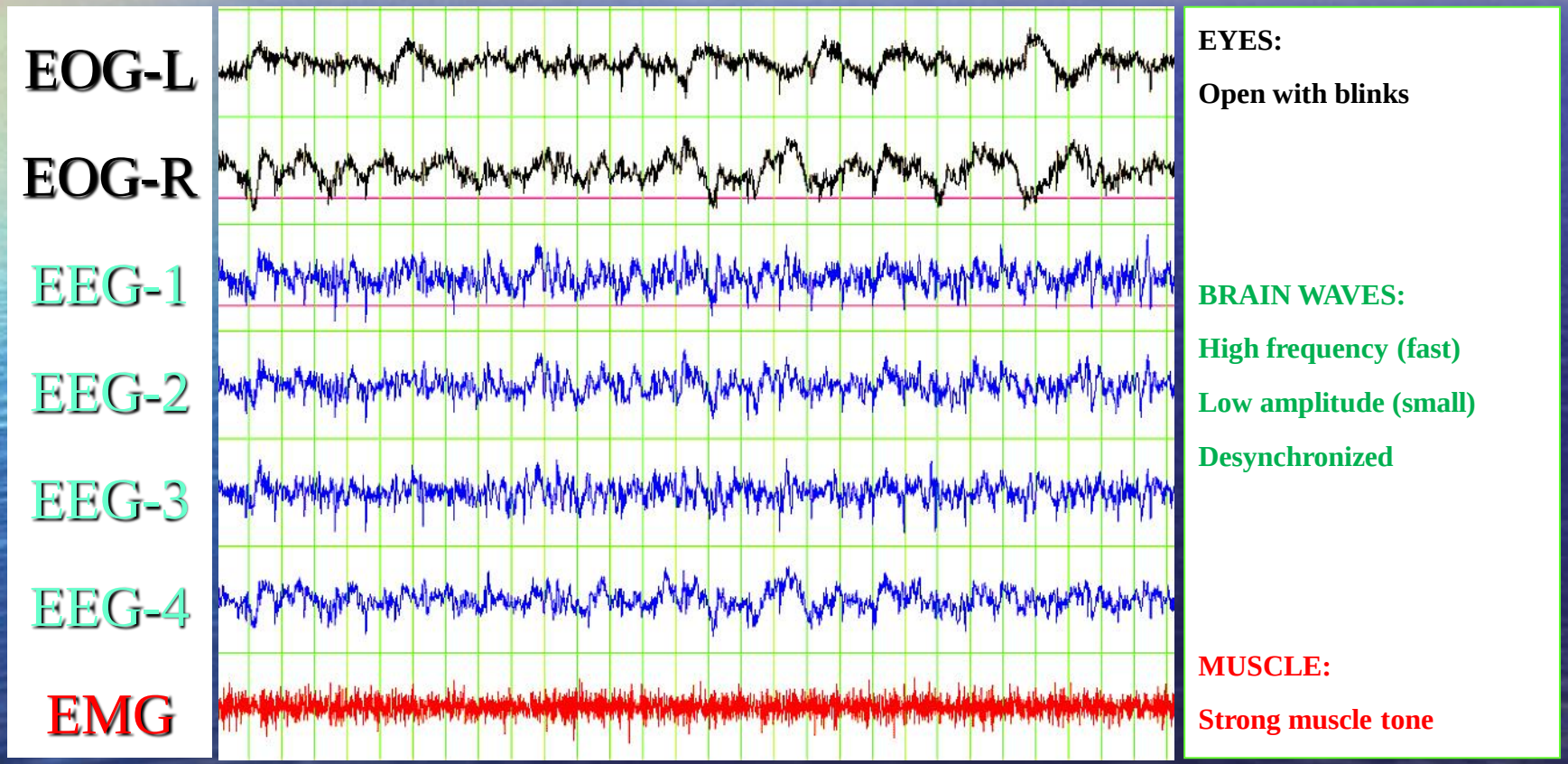
Measuring sleep

Polysomnography (PSG) Gold Standard

- Electroencephalogram (EEG)
  Brain Waves
- Electrooculogram (EOG)
  Eye Movement
- Electromyogram (EMG)
  Muscle Tone



Awake



EYES:

Open with blinks

BRAIN WAVES:

High frequency (fast)

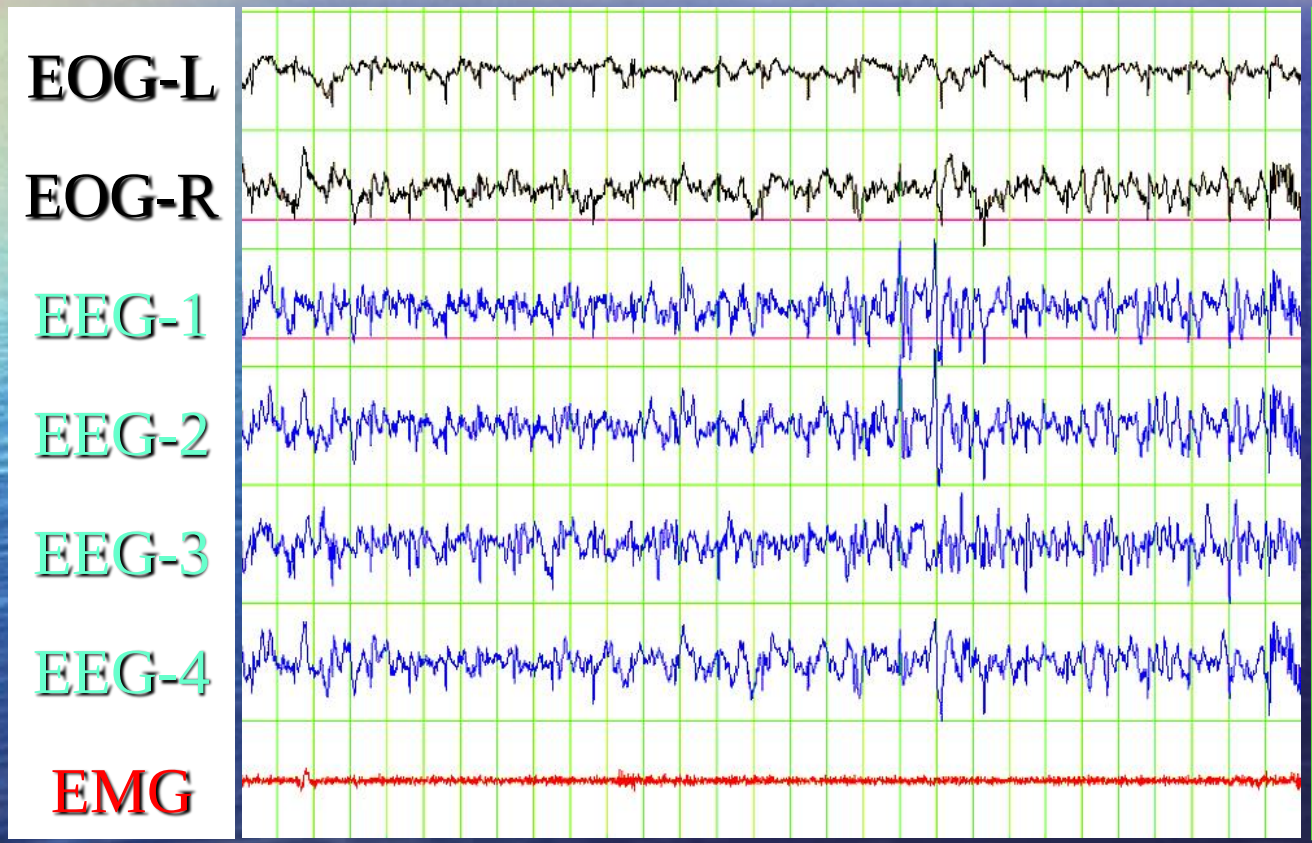
Low amplitude (small)

Desynchronized

MUSCLE:

Strong muscle tone

Stage 2 NREM



EYES:

Eye movements stop (slowly roll in Stage-1 NREM)

BRAIN WAVES:

Lower frequency (slower)

Higher amplitude (larger)

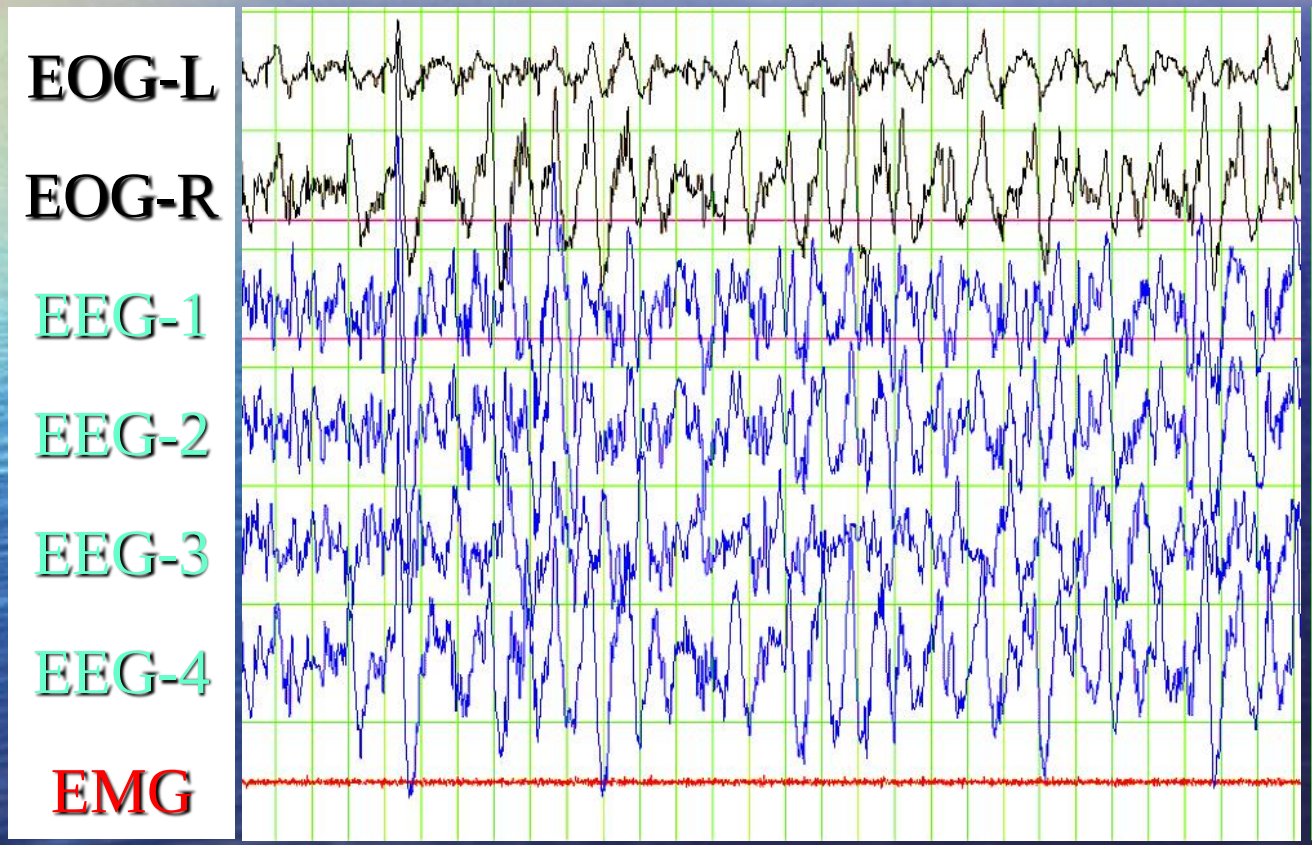
More synchronous

Special events: K-complex and Sleep Spindles

MUSCLE

Lowered muscle tone

Stage 4 NREM (SWS)



EYES:

No eye movements

(contamination from EEG)

BRAIN WAVES:

V. low frequency (SLOW)

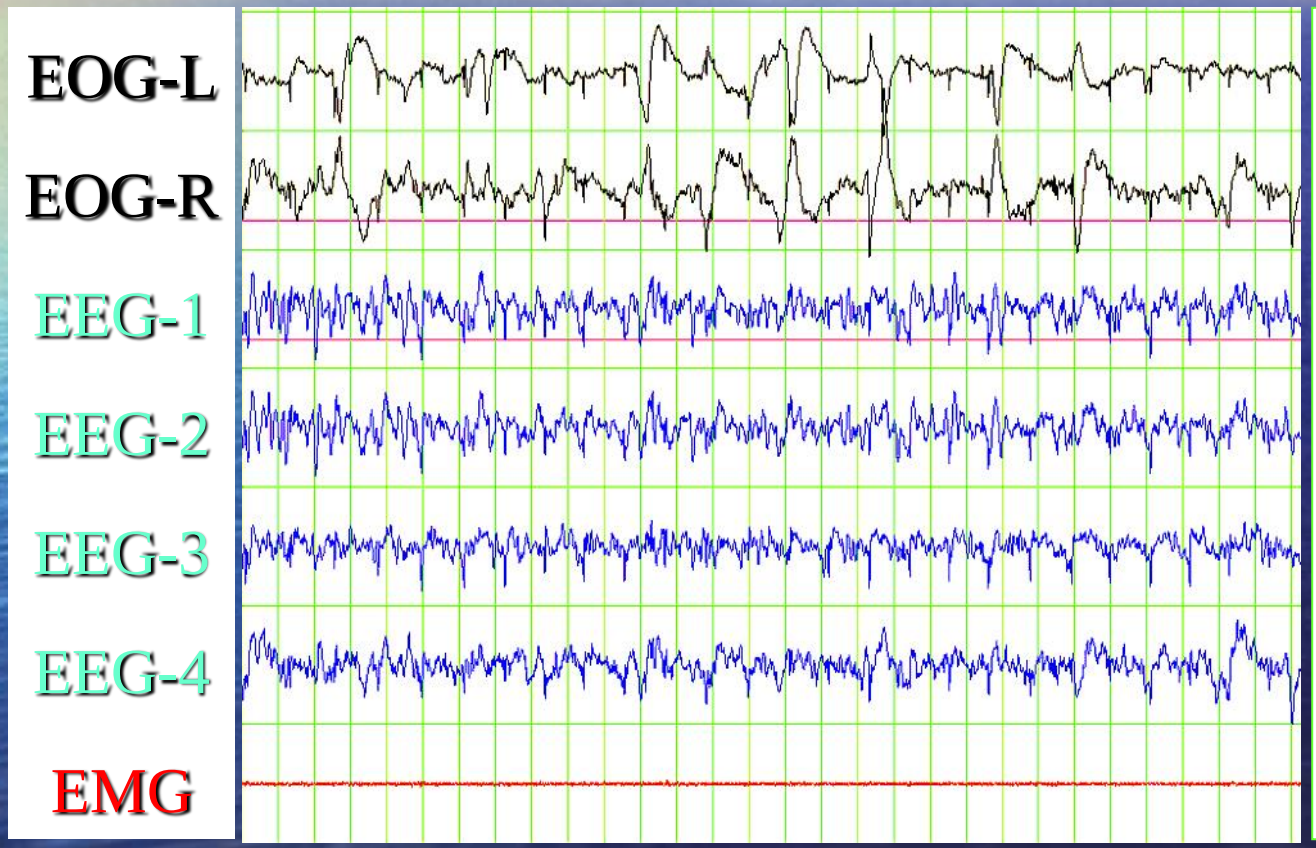
V. high amplitude (LARGE)

Synchronous brain waves

MUSCLE:

Lowered muscle tone

REM



EYES:

Eyes closed…BUT

horizontal movements - back and forth

BRAIN WAVES:

High frequency (fast)

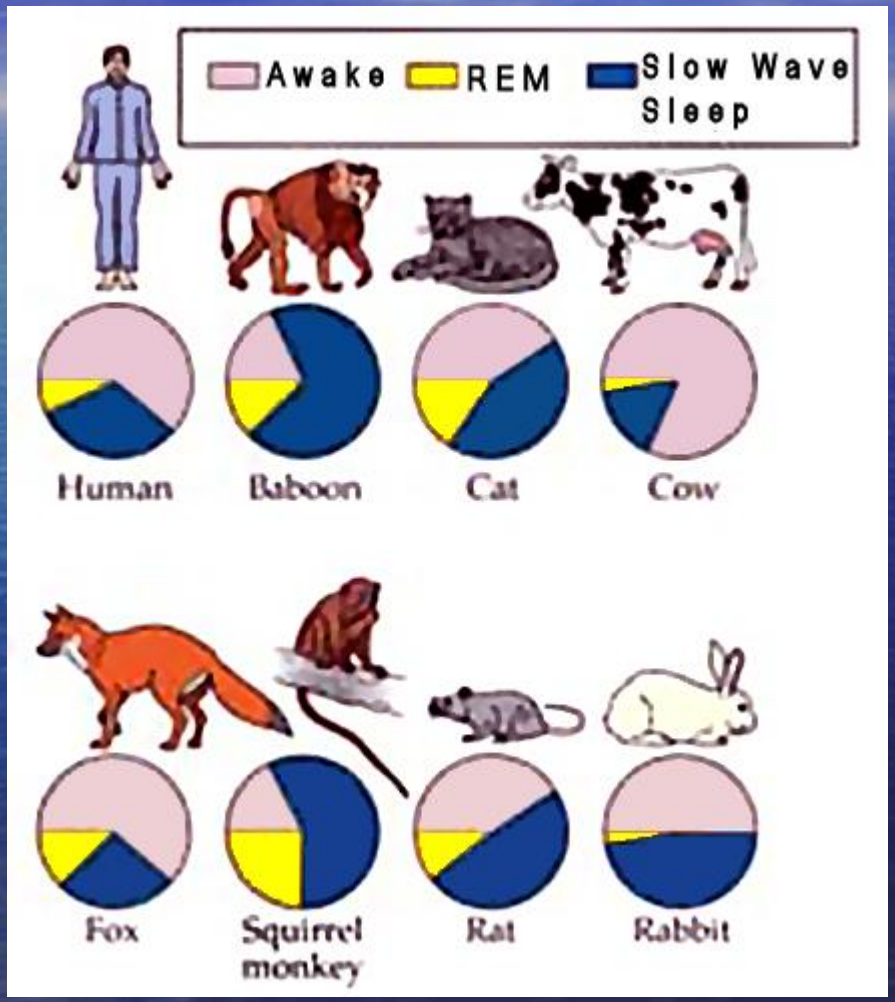
Low amplitude (small)

Desynchronized

(like awake)

Absent muscle tone

Animal sleep patterns



Limitations

Most is known about mammals where EEG can be easily used:

- Rodents
- Cats
- Dogs
- Monkeys

Less is known about:

- Birds
- Fish
- Reptiles
- Invertebrates

Do you have pets/ animals to observe?

Why sleep?

Potential evolutionary disadvantages?:

- Not eating or drinking (nutrient intake)
- Not reproducing
- More vulnerable (why do predators sleep?)

Potential evolutionary advantages?:

- Energy conservation
  - reduced activity when less productive
  - reduced metabolism
  - reduced body temperature (smaller mammals)
- Recuperation and restoration
- Consolidation of learning and memory

Energy saving

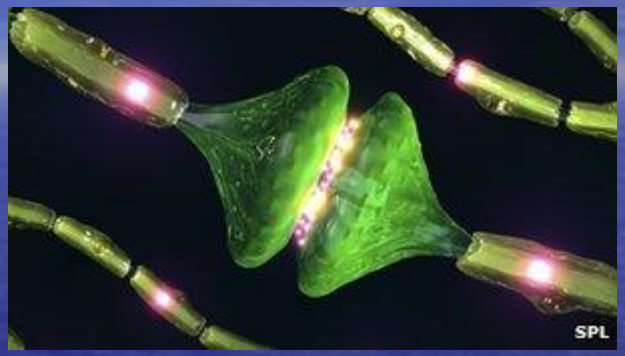
- While Non-REM (NREM) sleep saves marginal energy, it is equivalent only to about a slice of toast compared with resting in humans (80-130 calories)
- Partly because REM sleep increases brain activity and brain consumes 20% of body energy in humans
- Sleep is not the same as hibernation – quickly reversible, so less saving
- Aquatic mammals continue swimming while asleep

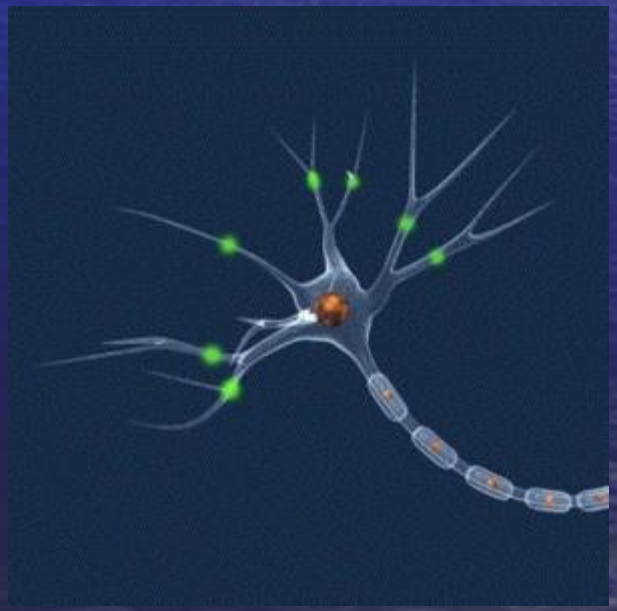
Recuperation

- Brain and major organs don't seem to have 'down time' -only the pre-frontal cortex effectively slows down
- Rested individuals often sleep more than highly active ones (more exercise does not lead to more sleep)
- Insomniacs show improved mortality rates (unless they take sleeping tablets)
- Some evidence of reduced immune system efficiency
- Evidence that some CNS gene expression changes in sleep with neurotransmitter replenishment (recent update!)
- No clear relationship to complexity of sleep cycles

Recent (2013) research

- Cutting back from 7.5 to 6.5 hours' sleep a night, genes associated with processes like inflammation, immune response and response to stress become more active. Also increases in activity of genes associated with diabetes and risk of cancer. The reverse happened when the volunteers added an hour of sleep.
- Myelin replenishment
  Sleep ramps up the production of cells that go on to make an insulating material known as myelin which protects our brain's circuitry.
- Sleep hits the reset button for individual neurons





Brain efficiency

- Sleep deprivation impairs attention, learning and memory and increases irritability
- ‘Sleeping on it’ can enhance ‘insight’
- Brain imaging shows area associated with recent neural stimulation (learning) remain active in sleep
- Sleep may critically facilitate efficiency but is not essential
- Relates only to animals with complex brains
- Length of sleep in animals is not correlated with brain complexity
- Correlational problem: is sleep there to facilitate brain efficiency or is it simply efficient to use sleep opportunities for some brain processes?

Sleep deprivation

As school science project (1965) Randy Gardner stayed awake for 11 nights.

Became progressively disorientated and impaired (blurred vision, slurred speech, moodiness, paranoia/delusions).

When finally allowed to sleep, he slept 15 hrs the first night and 10 hrs on the next two (he lost ~90 hrs but made up only 11 hrs).

Proportion of Stage 4 (68%) and REM (53%) increased radically. Suffered no obvious long-term harm - but rats deprived of sleep die within 3-4 weeks.

Negative deprivation effects

Negative Effects of Not Getting Enough Sleep

1. **Lower stress threshold.** When you're tired, routine activities, such as stopping at the grocery store on the way home from work, walking the dog or picking up the house can feel like overwhelming tasks.
2. **Impaired memory**. Deep sleep fosters the formation of connections between cells, and REM sleep aids in memory formation. Students considering pulling an all-nighter to study for that big exam might do better to get some sleep.
3. **Trouble concentrating**. When you're dragging yourself through the day, it's hard to stay alert and focused. This is why we don't want our pilots and surgeons to lose too much sleep. Sleep-deprived people have trouble focusing on tasks and overestimate their performance.
4. **Decreased optimism and sociability**. Whether it's the effort we have to put into staying awake or other factors, sleep deprivation makes us less hopeful and less friendly.
5. **Impaired creativity and innovation**. A growing body of research suggests that sleep deprivation may have a particular effect on cognitive processes that rely on our experience of emotions.
6. **Increased resting blood pressure**. Several studies have found that sleep deprivation leads to increased blood pressure (Fujikawa et al., 2009) and even half a night of sleep loss has been reported to increase blood pressure in people with hypertension or pre-hypertension (Lusardi et al., 1996).
7. **Increased food consumption and appetite**. Research indicates that acute sleep loss enhances pleasure response processing in the brain underlying the drive to consume food (Benedict et al., 2012). The researchers raise the question of whether chronic sleep deprivation is linked to rising levels of obesity.
8. **Increased risk of cardiac morbidity**. A number of factors can lead to an increased risk of heart attacks, and sleep deprivation is one of them. During experimental sleep deprivation of healthy participants, increases in inflammation associated with the future development of cardiovascular disease occurred.

Sleep disorders

- Insomnia
  - difficulty sleeping, daytime fatigue
- Sleep apnoea
  - “Laugh and the world laughs with you, snore and you sleep alone.” — Anthony Burgess
- Circadian rhythm disorder
  - jet lag, shifted sleep patterns, shift work
- Parasomnia
  - nightmares, sleepwalking, night terrors, acting out dreams
- Narcolepsy
  - unable to stop falling asleep

Insomnia

1 in 10 adults may have persistent insomnia

- 3 or more nights in 7 for more than 3 months

- Typical insomniac
  - Remains active right up to bedtime
  - Still involved with tasks of the day – work, dinner, email
  - Often has lights burning in the room in which he/she sleeps
  - Menopausal women also dealing with temperature flares – hot and cold
  - ADHD adults also coping with stimulant medication, caffeine, racing thoughts

Sleep apnoea

- Inability to breathe during sleep
- Common causes:
  - obesity, enlarged tonsils, throat and middle ear infections
- Possible cause of SIDS
  - (Sudden Infant Death Syndrome)
- Obstructive Apnoea is most common type and related to snoring (~1%)
- Central Apnoea is related to a CNS problem & is inherited

Parasomnia

Sleep Driving (2012)?

Becky Mason (28) drove 5 miles to work in pyjamas on a Saturday night and crashed her car after being turned away by a security man (she wasn't due in till Monday morning).

Was 3 times over the alcohol limit but was cleared of drink-driving by a Liverpool court on expert opinion that she was asleep until the crash occurred, hence "not responsible".

Defence was based on security guard's testimony and a family history of parasomnia.

Sleep hygiene

- Sleep practices can help you get to sleep more easily, sleep more soundly and feel more rested.

- Sleep hygiene can help you maintain your sense of health and well-being.

Sleep hygiene basics

- Protect your need for sleep
  - Ensure that you have 7.5-8 hours set aside for sleep every day
- Keep regular sleep hours
  - an erratic sleep schedule messes up your biological clock and can make getting a full night's sleep more difficult
  - go to bed at the same time every night and get up at the same time every morning
- Avoid vigorous exercise before sleep
- Avoid late afternoon or evening naps
- Avoid eating large meals before bed

Sleep hygiene basics

- Do not allow yourself to lie in bed and worry
  - get up and do something to alleviate the worry
- Avoid caffeine before bed
- Take a warm bath before bed if you have a particularly difficult time getting to sleep
- Listen to soothing music
- Use your bed only for sleeping (or sex!)
  - do not read, watch TV, or study in bed
  - learn to associate your bed with relaxation

Sleep hygiene basics

- Ensure a dark, quiet, cool environment
- Avoid oversleeping or lying in bed for prolonged periods of time after your sleep is completed

- "If you can't sleep, then get up and do something instead of lying there worrying.
  It's the worry that gets you,
  not the lack of sleep."

  Dale Carnegie

If you can't sleep . . .

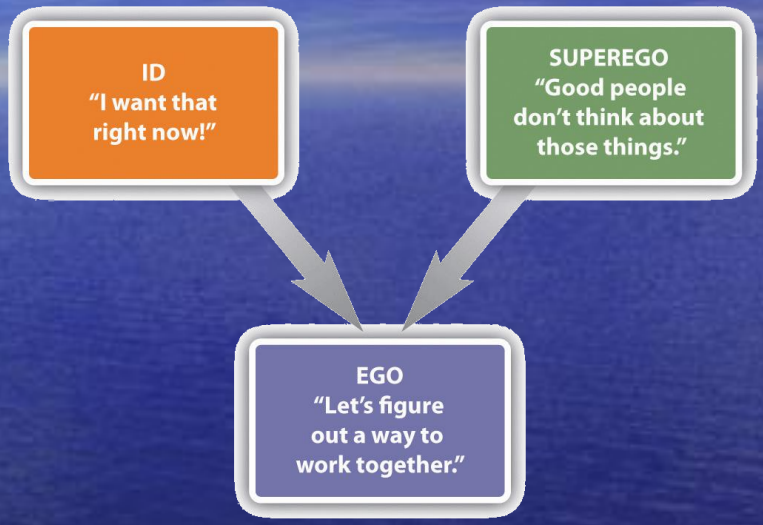
- Try not to care whether you fall asleep or not - sometimes worrying about falling asleep is enough to keep you awake
- Do something relaxing to distract yourself from you inability to sleep (relaxation is good!)
- Avoid activities like housekeeping, laundry, reading, etc. that will get you active
- Try boring activities
- Eat a light snack

Perchance to dream…

- Dreams as portents of the future (no evidence)
- Psychodynamic theory (Sigmund Freud)
  - 1900 *The Interpretation of Dreams*
- Physiological theory (Allan Hobson & Robert McCarley)
  - 1977 Activation-synthesis theory
- Cognitive theory (David Foulkes)
  - 1985 *Dreaming: A cognitive-psychological analysis*

Freud on dreams

- **Id:** unconscious, drives and desires, unsocialized
- **Super-ego:** partly conscious, ideals, morality, ("conscience")
- **Ego:** conscious, socialized



- "Dreams are the royal road to the unconscious"
- A dream is the expression of the goals of biological drives, especially sexual drives
- The drive activates the brain and the interaction of drive and psychological controls creates the dream

Psychodynamic theory

- Dreams as a window on the unconscious mind
- Dream as ‘wish fulfilment’
- Day residue and manifest content
  - Day residue consists of events of the day that are part of the dream
  - Manifest content is the explicit story of the dream
- Latent content and dreamwork
  - Dreamwork converts latent content into symbols to present as manifest content
- Free association
- Defence mechanisms

Dreamwork

- *Displacement*
  - One element stands for another element
- *Condensation*
  - Two or more elements are fused into one
- *Visual images*
  - Use of visual image to represent an element
- *Secondary revision*
  - Creating a coherent narrative after changes

Interpretation

- Goal is to uncover the latent content through analysis of the manifest content
- Method is to express and explore the associations made to dream elements
- Problems:
  - Dream is recalled at a distance in time
  - Individual is psychologically distressed
  - Therapist prompts details
  - How to validate the interpretation

Physiological theory

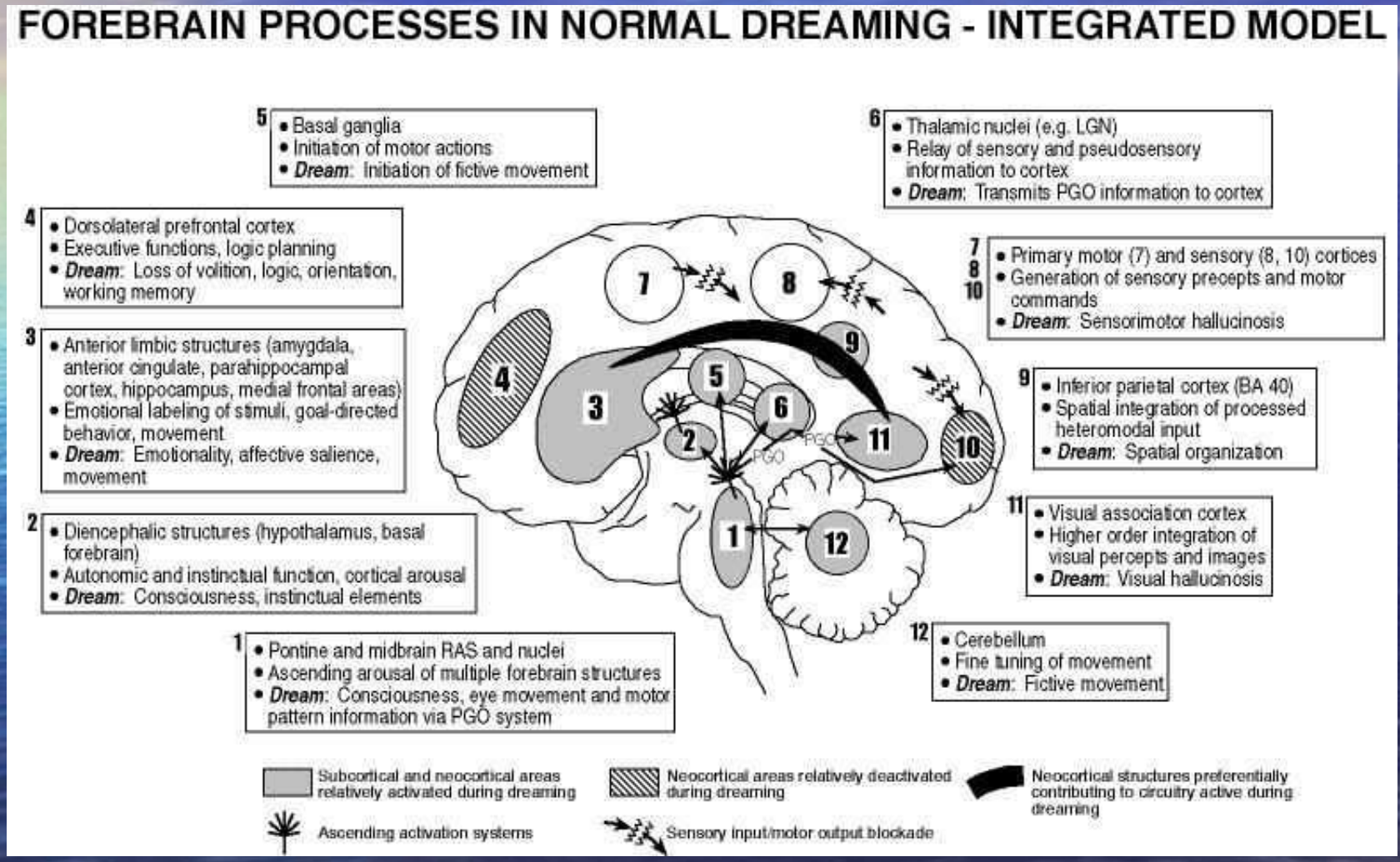
Activation-synthesis theory

- Activation of reticular formation (primitive brain)
  - Biological rhythm of sleep-wake cycle produces activity in reticular formation, which activates various brain centres
- Synthesis by cortex of activity
  - Primary source of dreams are stimuli generated within the brain
- Activation of cortex
- Rapid eye movement
- Vestibular activation
- Inhibition of motor neurons
- Autonomic activation

Synthesis

- Visual imagery
  - activation of visual cortex
- Flying
  - Vestibular activation produces disoriented spatial sense, which is interpreted as flying
- Chase dreams
  - Motor cortex activation generates commands to legs, but inhibition of motor neurons means there is no kinaesthetic feedback

Explaining dreams



Interpretation

- Goal is to relate dream content to activation of different parts of the brain
- Method is to record physiological measures and correlate those measures with activity in dream reports
- Immediate reports from subjects in sleep laboratory with controlled sleeping conditions
- Problems:
  - Possible distortion of content from lab setting
  - No way to directly identify content of dream from physiological measures
  - Participants' goals may not be known

Cognitive theory

- Dreams as a form of information processing
  - Dreams are symbolic acts
  - Dreams are based on what we know
    - children have simpler dreams than adults
  - Dreams use dissociated pieces of memory and knowledge
  - Dreams are organized
  - Dreams have realistic features
    - People are people; objects are real

Diffuse memory

Mnemonic (stored memory) activation

- Dream elements are activated on a haphazard basis, due to residual activation from daytime, passive associations, etc.
- In contrast to Freud, elements are **not** activated by underlying sexual desires

Dream production

Dream production system

- Makes sense of active elements by creating a story
- One system for REM and NREM
- Dream recall is difficult because story construction is incompatible with story encoding

Children's dreams – increasing cognition

- Increase in length with age
- Change from static to 'kinematic'
- Change from animal to social characters
- Increase in representation of self

Interpretation

- Goal is to understand dream content in terms of processing in cognitive theory
- Method is to relate dream report to events in life
- Problems:
  - Retrospective
  - Cognitive bias

Lucid dreams

- Dreamer aware they are dreaming but allow it to continue (c.f., psychotic hallucinations; believed to be real).
- Lucid dreamers may have control over the direction of the narrative.
- Some people able to learn this capacity and harness it for creativity or treatment of distressing nightmares.

Sleep paralysis

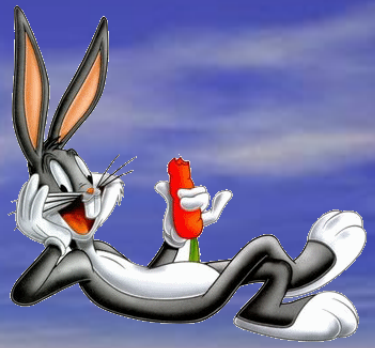
- Common nightmare is an evil presence (ghost or *incubus*) in the bedroom pressing down on our body. Another is being unable to run away from something in pursuit.
- May be related to fact that limbs are effectively paralysed during REM sleep.
- Occurs at fringes of waking and REM sleep; seems very real.
- More likely when sleep disrupted by stress, shift work, alcohol, etc.
- May account for some reports of astral projection and alien abduction.

Finally

"The fact that a third of our life is spent in sleep would, in itself, be sufficient justification for studying it scientifically. However, the discovery that it is not just a passive state but a highly active process of profound biological and psychological importance, has led to great efforts in recent decades to further our understanding of it. Despite that, we are far from unravelling all of sleep's mysteries."

Professor Glenn Wilson, 2013

That's all folks…



Thanks for listening (and not falling asleep!)

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Think about it

The Edinburgh Philosophy and Psychology Group

The Links Hotel and Bar
4 Alvanley Terrace
Edinburgh EH9 1DU
(Bruntsfield Links)

Non academic discussion group
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