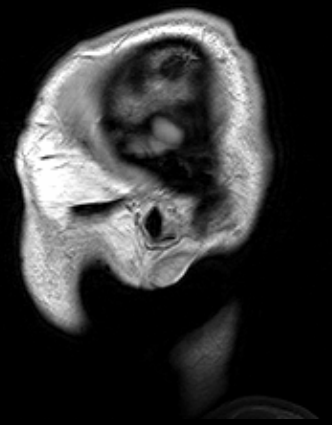
Institute of Psychiatry at The Maudsley

KING'S College LONDON

The Neuroscience of Stress and Sleep Deprivation

Professor Geoff Bird



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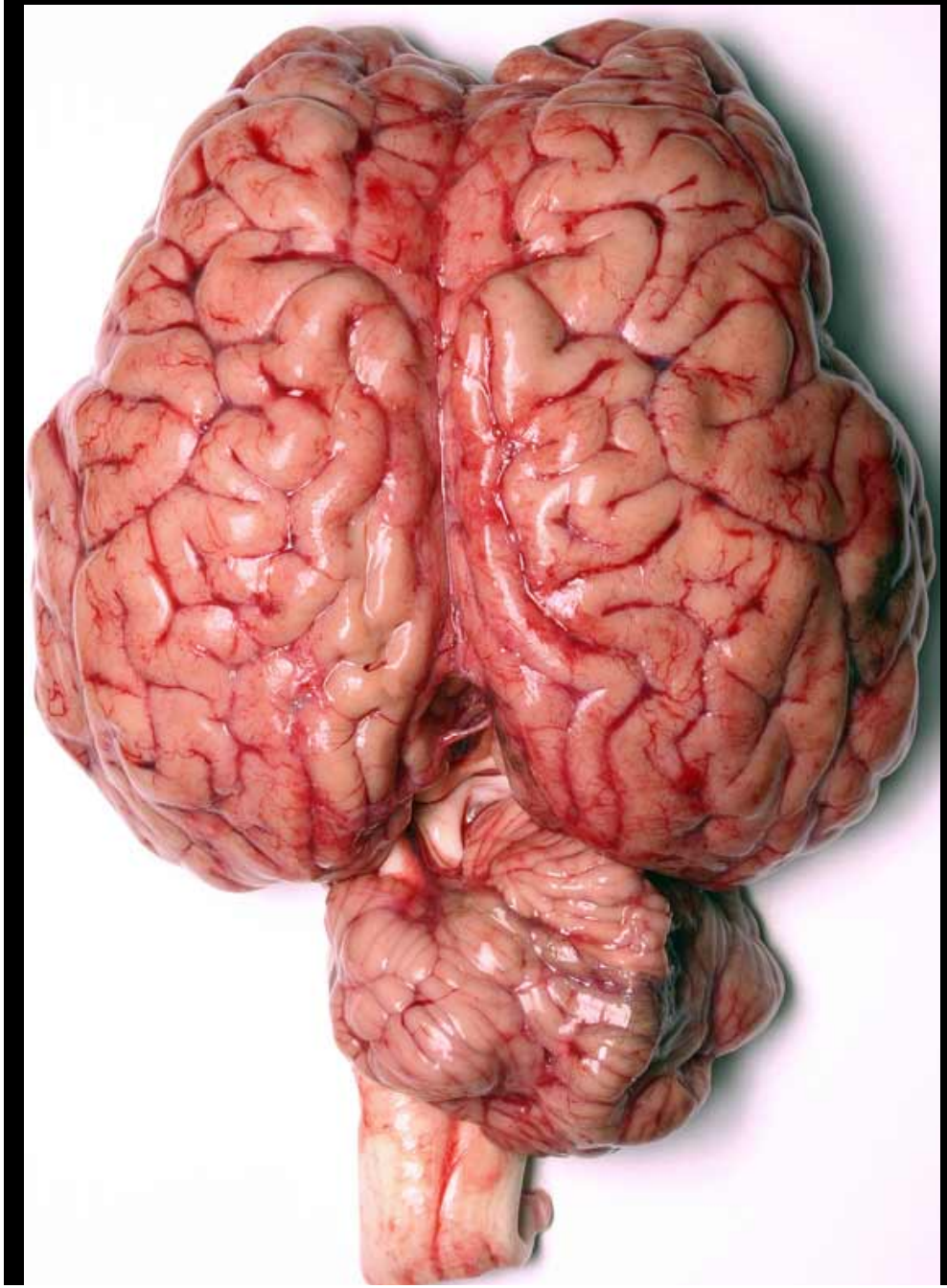
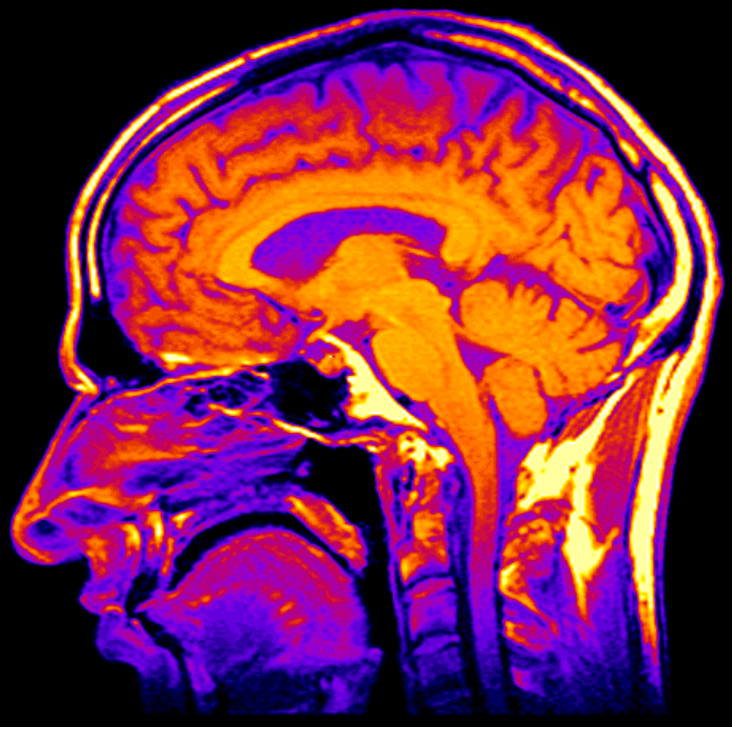
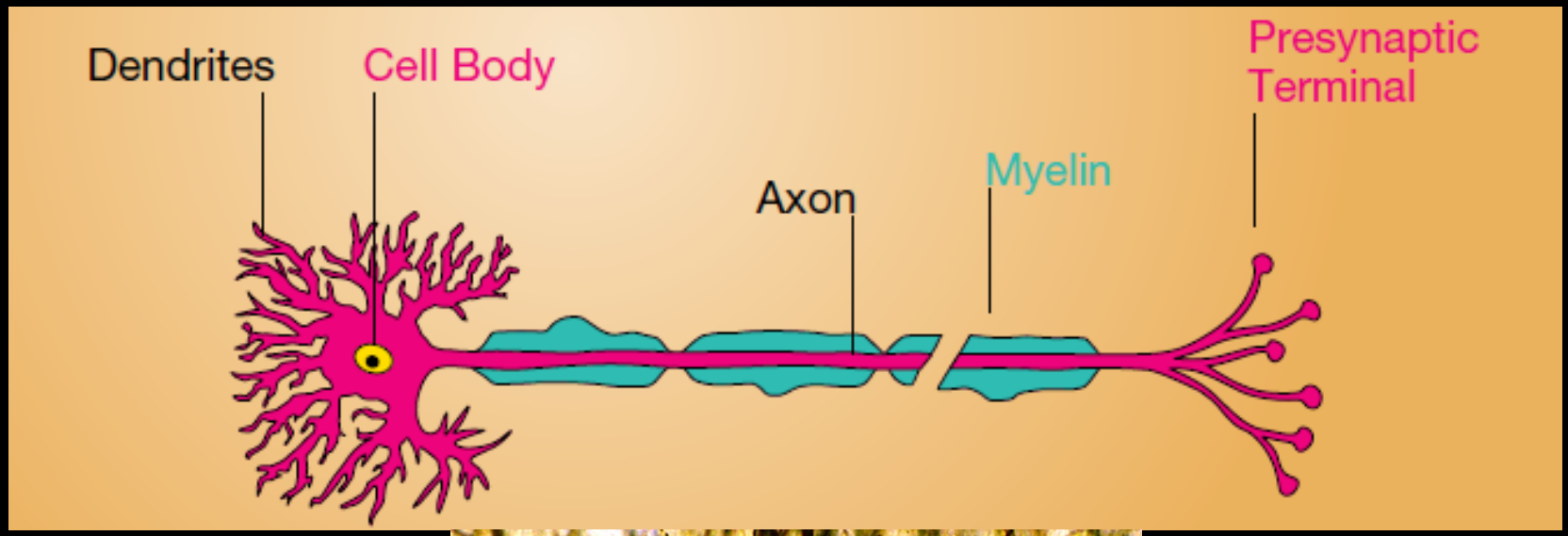
Human Brain



1.4kg in weight and consistency of set yogurt.
Consists of 100 billion neurons which are connected by 100 trillion connections (synapses).
1 trillion ‘support’ cells.
Consumes 60% of daily intake of glucose and responsible for 30% of our calorie use.

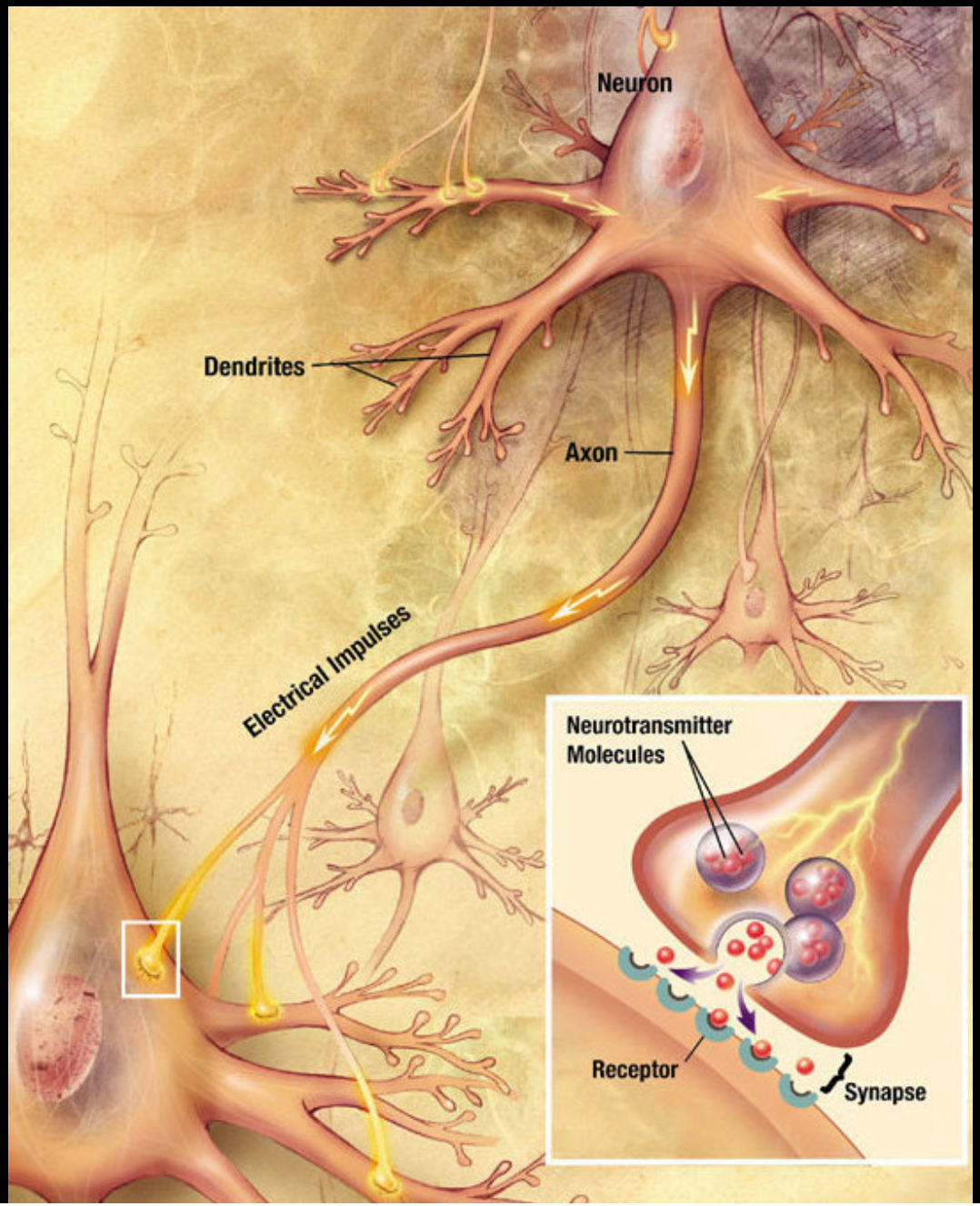


Neurons



Myelin = 100s mph
176,000 km of white matter in brain.

Synapses: Biological Basis of Learning



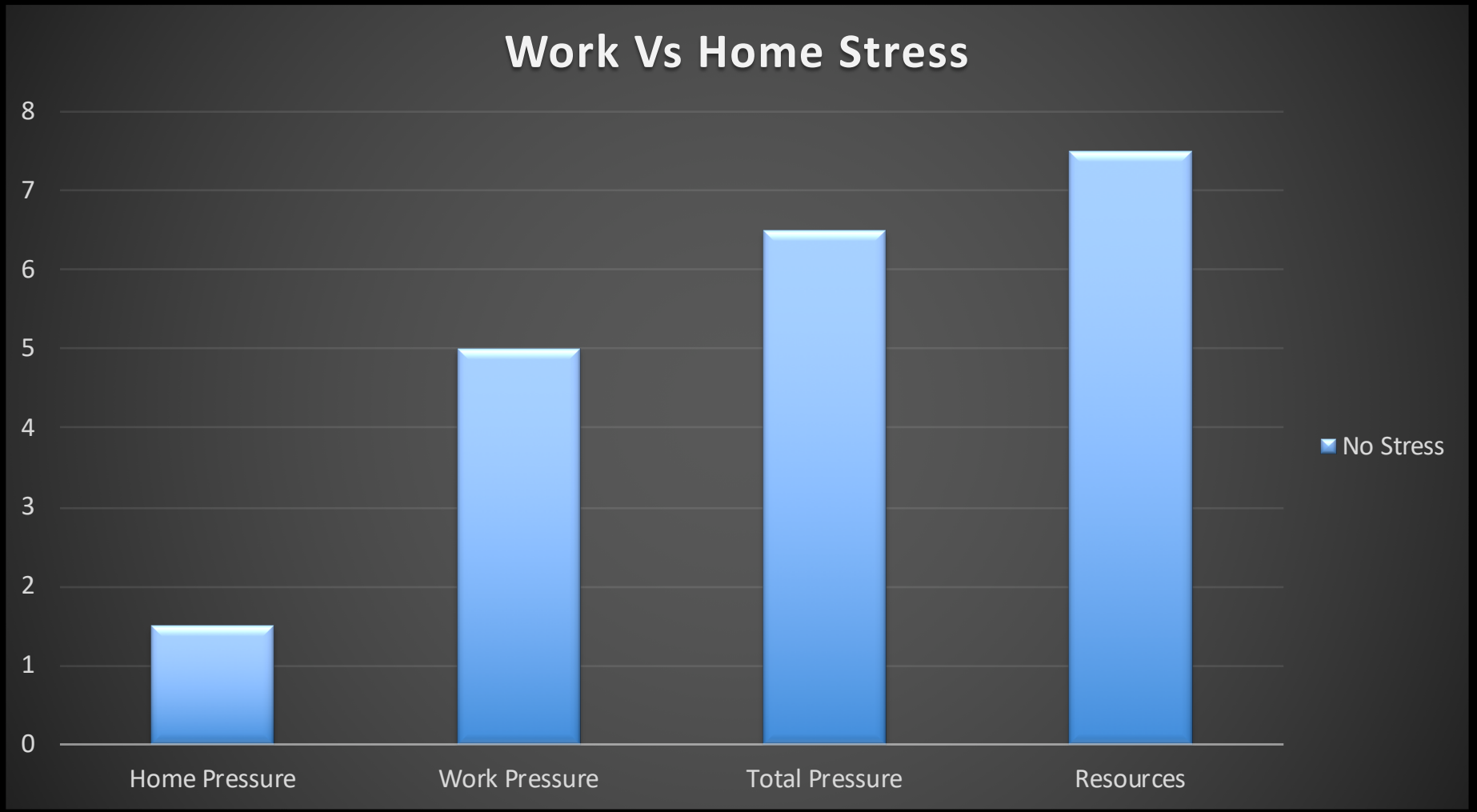
Stress and Its Effect on the Brain

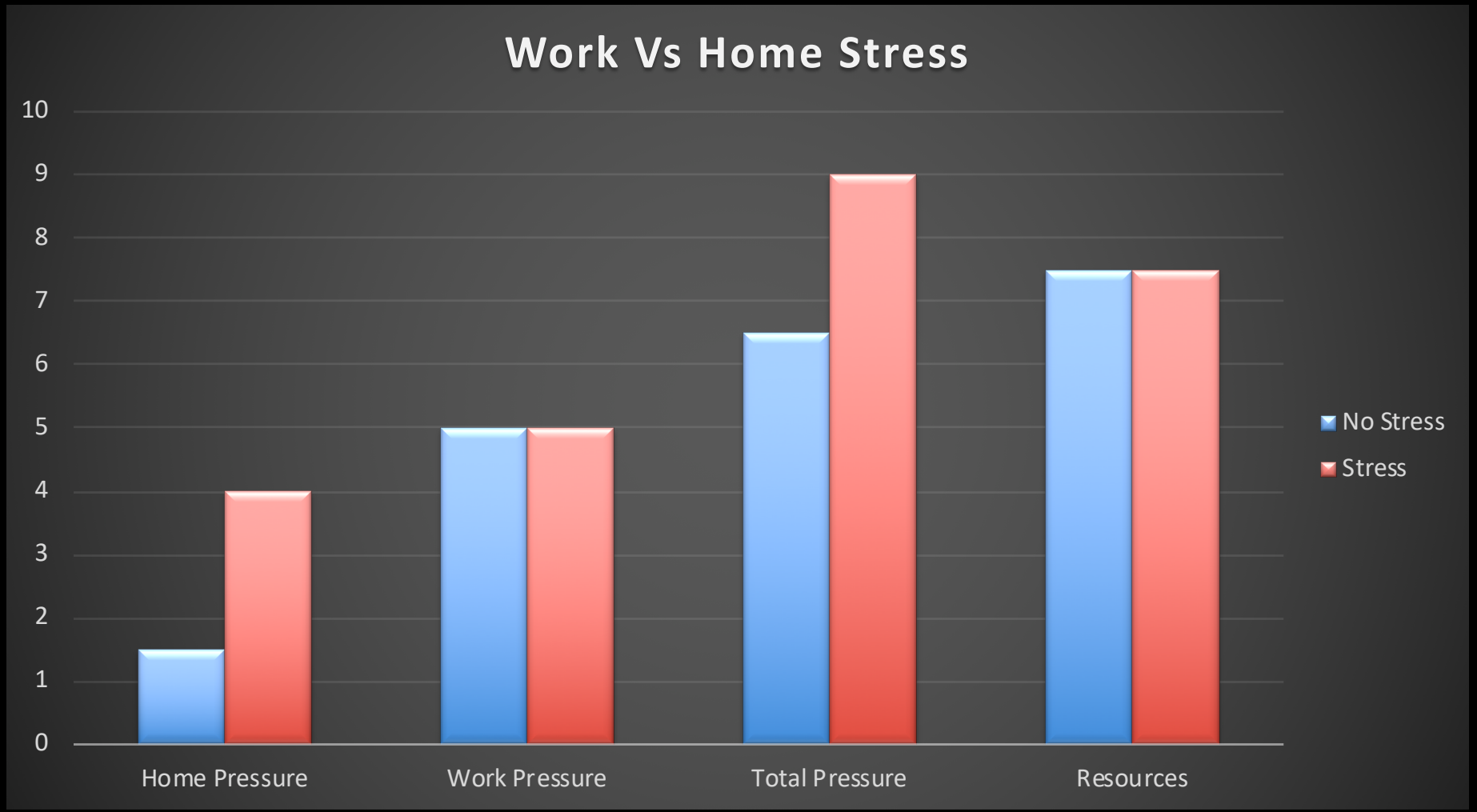
What is stress?

- Workload not main determinant.
- Perception of workload and ability to meet demands.

- Perception of demand > perception of resources

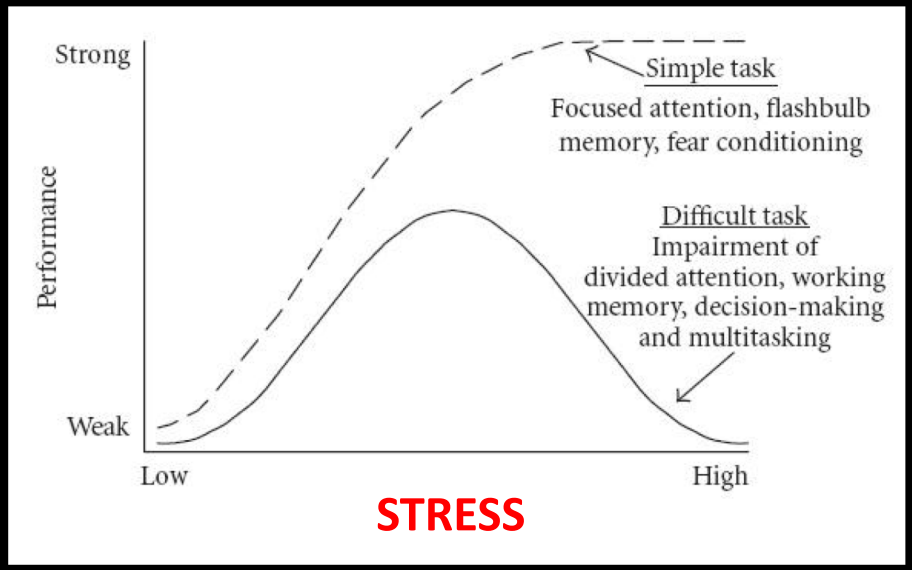
- If that's all that managers did would be enough to make them value for money.


Work Vs Home Stress
8
7
6
5
4
3
2
1
0
Home Pressure
Work Pressure
Total Pressure
Resources
No Stress


Work Vs Home Stress
10
9
8
7
6
5
4
3
2
1
0
Home Pressure
Work Pressure
Total Pressure
Resources
No Stress
Stress

Stress Time-course

- Performance: Initially beneficial – long-term damaging.
- Narrows focus – impairs learning & creativity



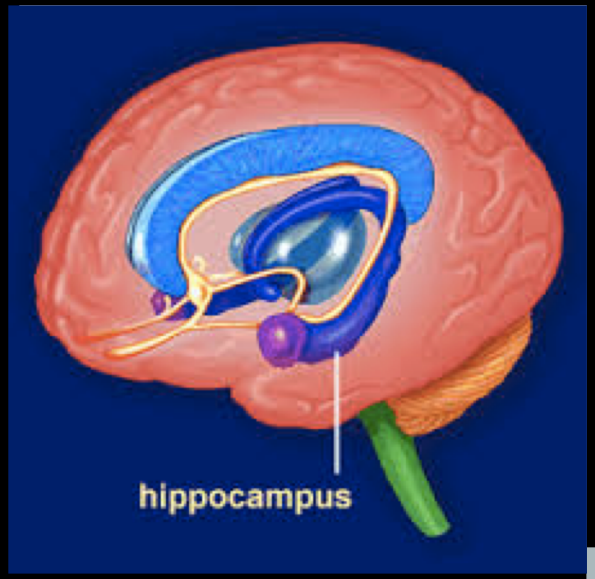
- In the brain: Prolongs time before neurons get tired. If continues too long damages neurons.

General Stress Effects

- Stress affects Blood-Brain barrier which is there to protect brain.
- Directly affects immune system (Killer T cells) meaning you are vulnerable to infection.
- Stress precedes psychiatric illness in genetically susceptible individuals.
- Link to strokes and heart attacks.

The Hippocampus

- So called due to its resemblance to a seahorse.
- Part of the limbic system (next to the Amygdala)



Importance of the Hippocampus

- HUGE role in learning and memory - transferring information from Short-term memory to Long-term memory (ageing / AD)
- Also emotional reactivity / control.
- VERY vulnerable to stress – makes it harder for neurons to fire, damages existing synapses, harder for new synapses to form, kills neurons (age effects on reversibility).

Neurogenesis in Hippocampus

- 9000 new neurons a day in hippocampus (rat)
- Linked to memory function and plasticity.
- More new cells, better ability to learn.

- **Stress reduces neurogenesis.**

Implications

- Stress is not something that just affects how you feel, it affects how you perform.
- Significant impact on ability to learn and creativity.
- Increase risk of depression – Legal / ethical implications?
- It’s in employers’ best interests to reduce stress – not just for ‘soft’ factors.

Implications for Managers

- Managers can impact upon:
- Perception of coping resources
- Strategies / barriers to reduce workload
- Resilience

- ‘Hold up mirror’ to levels of stress / burnout
- Identify negative consequences – not worth ‘just toughing it out’.

Managers as Front-Line Defence

Perception of stress:

- Female's work-home conflict rated higher.
- No gender differences in self-reports.
- Overestimation of conflict led to low ratings of person-job fit, performance, and promotability.

Managers as Front-Line Defence

Stress Mindset:

- Stress as debilitating vs enhancing.
- SE Mindset less likely to recognise burnout, presenteeism, physical symptoms of stress.
- SE Mindset less likely to reduce promotability judgements for stressed people.
- SE Mindset less likely to help stressed people.

Signs of Stress: Work Performance

Poor concentration
Inconsistent performance
Uncharacteristic errors
Indecisiveness
Inability to deal with things calmly/ irritability
Signs of tiredness or anxiety
Making complaints
Lapses in memory
Resistance to change
Lack of holiday planning and taking
Longer or excessive hours

Signs of Stress: Withdrawal

Arriving late

Leaving early

Extended lunches

Absenteeism or increased sickness absence

Passivity or lack of commitment

Signs of Stress: Aggression / Substance Use

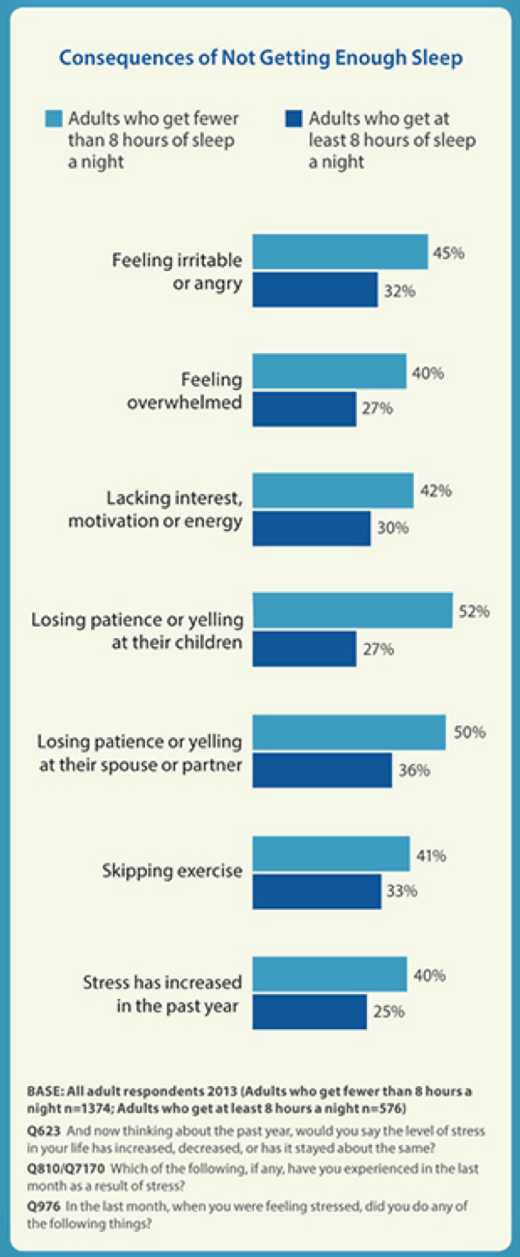
- Malicious gossip
- Criticism of others
- Vandalism
- Shouting
- Bullying, harassment
- Increased drinking of alcohol and/or coffee
- Increased smoking
- ‘comfort eating’

The Stress / Sleep Vicious Circle

Stress and Sleep

- Stress → Sleep Deprivation → Stress →…
- 70% of stressed individuals report major impact on sleep (1hr a night less, 4 x worse quality). 75% becomes source of stress itself.
- Sleep Deprivation increases stress hormones – damage tissue (heart skin etc). Doubles risk of death from all causes. Accidents & driving.
- Increases emotional reactivity leading to stress.

ADULTS WHO SLEEP FEWER THAN EIGHT HOURS A NIGHT ARE MORE LIKELY TO REPORT SYMPTOMS OF STRESS.



BASE: All adult respondents 2013 (Adults who get fewer than 8 hours a night n=1374; Adults who get at least 8 hours a night n=576)

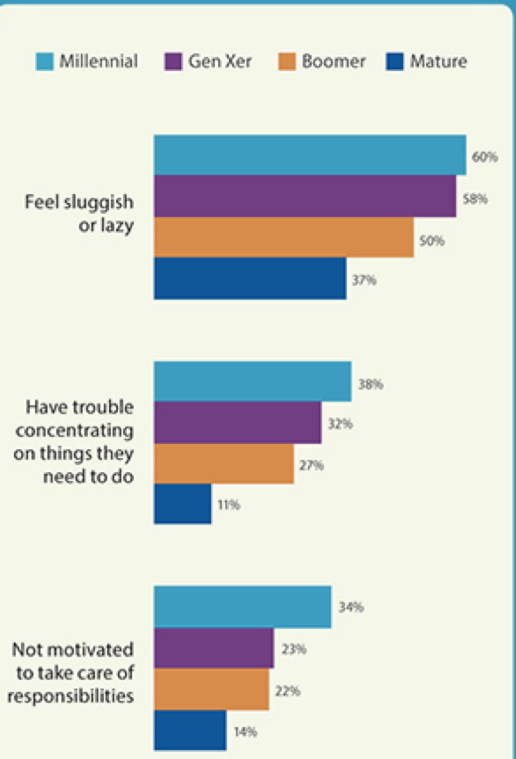
Q623 And now thinking about the past year, would you say the level of stress in your life has increased, decreased, or has it stayed about the same?

Q810/Q7170 Which of the following, if any, have you experienced in the last month as a result of stress?

Q976 In the last month, when you were feeling stressed, did you do any of the following things?

Younger adults more likely to feel stressed by sleep deprivation and to report negative effects of sleep deprivation.

YOUNGER AMERICANS ARE MORE LIKELY TO REPORT CONSEQUENCES OF UNHEALTHY SLEEPING HABITS.



BASE: All respondents 2013 (Millennial n=392; Gen Xer n=379; Boomer n=808; Mature n=371)

Q760 How much sleep are you getting?

Q765 On average, how many hours do you sleep at night?

Q775 In general, how would you describe the quality of your sleep?

Q1785 Which of the following best describe how you feel or behave when you do not get enough sleep?

Sleep Deprivation (SD)

- Lack of sleep impacts learning / memory consolidation (impacts on hippocampus).
- Impacts creativity (more than twice as likely to find novel solution to mathematics problem after good night's sleep).
- Large effects on emotion: Impairs control of emotion as increases connectivity between amygdala and fight or flight systems and decreases connection with prefrontal cortex control regions.

Poor Sleep

- One of first signs of mental health problems – anxiety, depression, mental health nurses.

- REM sleep directly modulates amygdala & hippocampus activity and impacts on stress hormones.

Specific Effects - 1

- Less control of emotions means they are amplified.
- Short sleep deprivation can have anti-depressant effects but typically negative effects.
- Always negative for chronic deprivation (5hrs a night).

Specific Effects - 2

- SD + Stress particularly bad for mental health, all aspects of emotion processing, emotional decision-making.

- Also reduces interpersonal skills: Lose ability to recognise other's emotions (big effect) also impacts on your own expression of emotion.

Implications

- Poor sleep may not currently be a red flag for managers but it should be.
- SD leads to exaggerated emotions, seeing threats where they don't exist, poor emotional control and resultant poor decision making, poor ability to express your own emotions and recognise those of others. Also impacts on learning and memory. Like being a teenager.
- Also related to anxiety (sleep quality and alcohol)
- Not just an issue for individual to deal with.

Implications - ‘Positive Effects’

- Short-term effects of SD lead to enhancement of any emotion, including positive.
- Due to disconnection between positive emotion areas (dopamine-related areas of limbic system and ventral striatum) and areas concerned with emotion regulation (prefrontal cortex).
- Drives risky reward-seeking behaviour such as promiscuity & gambling – impairs decision making (casinos).
- Napping (~90mins) helps positive mood effects.
- Good night’s sleep resets amygdala reactivity and connectivity with control areas.

Stress Reduction

No Surprises…

- Social Support – Culture, managerial oversight, peer support groups.
- Diet – particularly in supporting sleep.
- Exercise
- Explicit stress management techniques.

Mindfulness

What it is and How it Works

What is it?

"paying attention in a particular way: on purpose, in the present moment, and non-judgementally." Kabat-Zinn, 1994.

- Focused attention / attention regulation.
- Body focus.
- Non-Judgmental self perspective.
- Detached focus.

- Personality trait - The Kentucky Inventory of Mindfulness Skills

- MBSR / MBCBT / ACT (acceptance & commitment)

MBT/MBCT is effective for:

- Anxiety – Depression – Self Esteem – Self Efficacy - Self Harm – Obesity – Other Eating Disorders – job satisfaction – burnout – stress – addiction relapse – family relationship quality –rumination – OCD – creativity – alcohol problems – general psychological health – controlling the autonomic nervous system – increasing attentional capacity (control duration and effectiveness) - Blood pressure - fatigue - quality of life – sleep quality – anger – hypersexuality – brain response to errors - empathy – paranoia – (brain changes) – immunity – planning – good effects on coaches and presumably coaching practice from medical models – PTSD symptoms – cravings – chronic headaches – improves working memory, focus, and reading comprehension – work-life balance – substance abuse – Pain control – immune function – attentional biases – rumination – emotional exhaustion – social anxiety – balance – genes related to inflammation – test anxiety – hyperchondriasis– blood pressure - sexual response – reduce emotionality – stereotype threat.

Brings About…

- Better communication
- Client-centered approaches in medics.
- Increase in compassion
- Long-term change
- Increased sleep-related brain plasticity

Suitable for…

- Adolescents, people with LDs, older adults, different racial and ethnic groups, cancer survivors, heart disease patients, online delivery, those with ADHD, telephone delivery, those with autism, chronic pain, PTSD, stroke patients.

How does it work? Psychology

- Effects on anxiety and stress seem to be caused by a reduced tendency to worry / ruminate. Mindfulness allows better thought control.
- Effects on depression work through worry / rumination and encouraging reappraisal (rather than suppression).
- Effects on addiction / maladaptive behaviours due to impulse control, reappraisal of rewards.

How does it work? Neuroscience

- Hierarchical System: Amygdala at lowest level, then insula, then ACC.
- Information flows between them – with higher levels able to influence lower levels (‘turn them up or down’).
- MBI result in greater connectivity between them and more developed ACC and insula.
- Allows greater control of emotions, greater stress response, greater attentional control.

A word of caution

- Mindfulness is not a super therapy – for serious problems essential to have clinical support.
- Ideal to have mindfulness programs / mindfulness training administered by qualified clinicians.
- See ninetytenpsychology.com

Implications

- Mindfulness certainly useful for employees.
- Certainly useful for the managers.
- Training courses relatively cheap and low investment.
- Huge amount of scientific validity – encourages buy-in.

- Social support equally useful. Active steps to change culture.

Improving Sleep

What makes us sleepy?

- Mental/neural tiredness is direct result of circadian rhythms and time spent awake.
- Adenosine (NT) builds up when awake – inhibiting brainstem systems promoting wakefulness.
- Caffeine blocks effect of adenosine doesn't do much to circadian rhythms.
- Big genetic effects on effects of circadian rhythms.

Sleep Hygiene

1. Consistent bedtimes, consistent routine.
2. Keep bed for sleeping – no TV, reading, etc.
3. Avoid stimulants – Caffeine 5/6 hrs Nicotine 3hrs.
4. Regular exercise though not in evening.
5. Cool room.
6. Notebook by bed.
7. Alcohol not useful.

Sleep and The Smartphone

- Why *might* we be concerned?

1. Mental Effort
2. Emotional Arousal
3. Light levels (suppressing melatonin).

- What might we be concerned about?

1. Time to Sleep
2. Sleep Quality
3. Sleep Duration

Sleep and The Smartphone

- What is the evidence?

1. Effects of mental effort and physiological arousal very real.
2. Impact on time to sleep – no evidence on sleep quality or duration.
3. Computers > Mobile Devices > TV.

4. Effect of Light on melatonin real, but swamped by other sources (Ipad on full brightness in dark room for 2hrs then tiny effect – not for 1hr.

Sleep and The Smartphone

- Summary

1. Mental effort & physiological arousal delay sleep.
2. Light effect is important – but really we are talking about daylight.