MORE ASPECTS OF SLEEP:

ESSAYS EMPHASISING RESEARCH METHODOLOGY

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1. WHY DO ANIMALS SLEEP?

1.1. INTRODUCTION

"Every animal studied to date engages in some form of sleep or sleep-like behaviour" (Lima et al 2005 p723). For example, in mammals daily sleep ranges from four to nineteen hours (Zepelin et al 2005)(appendix 1). Most research is upon sleep in mammals, and then birds, but sleep-like behaviour has been observed in retiles, amphibians, fish, and invertebrates (eg: bees, fruit flies)(Lima et al 2005). So it could be that sleep is required by animals, but this is disputed by the theories of why sleep evolved.

Establishing whether all animals need sleep or not is hampered by a number of problems (Zepelin et al 2005):

- Sleep may be difficult to recognise in some species; eg: blind Indus dolphins (Platanista indi) sleep for seconds while ever-swimming (Pilleri 1979);

- Some species may be able to postpone sleep for long periods, like during migration;

- Defining sleep - eg: cetaceans are not immobile while sleeping; horses and giraffes sleep standing;

- Differences in brain structures between species - eg: electrodes attached to the skull of reptiles is less effective for measuring electrical activity of the brain compared to mammals. Eiland et al (2001) found no evidence of Rapid Eye Movement (REM) sleep in box turtles (Terrapene Carolina major) based on measuring neuronal activity in the midbrain and pontine regions of the brain. Different patterns of electrical activity were found compared to the same areas of mammal brains.

However, most animals show common characteristics of sleep:

i) Different types of sleep - Deeper (non-REM or Slow Wave Sleep; SWS) and lighter (REM) sleep. REM sleep varies from 10 to 50% of sleep time in mammals and less than 5% in birds (Zepelin et al 2005);

ii) "Sleep cycles" - Alternating periods of SWS and REM sleep;

iii) Monophasic (sleeping once a day for a long period)(eg: primates) or polyphasic sleepers (sleeping for several periods in the day; eg: rodents);

iv) Bihemispheric (both sides of the brain asleep) or unihemispheric sleep (one cerebral hemisphere remains awake; eg: some birds and reptiles).

Unihemispheric sleep found in birds has a number of functions including vigilance against predators, monitoring the position of mates or offspring, and restoration (Wellmann and Downs 2009).

Experiments have also shown sleep-like activity in one part of the cortex while neurons in other parts are "awake" (eg: "drowsy" monkeys, Macaca fasicularis; Pigarev et al 1997).

Laboratory studies of sleep behaviour are confounded by the fact that captivity could influence time spent sleeping. But accurate measures of sleep in wild animals is difficult, and the use of electroencephalography (EEG) requires surgery with the invasive and post-operative recovery problems.

However, Rattenberg et al (2008) reported the use of recently developed miniaturised EEG recorders with brown-throated three-toed sloths (Bradypus variegatus)(figure 1.1) on Barro Colorado Island, Panama. Studies of these animals in captivity have measured nearly sixteen hours (15.85) sleep per day (De Moura Filho et al 1983).

Three adult females were fitted with the EEG recorders that were attached with minimal invasion to the head. The study found that only about ten hours (9.63) per day was spent sleeping (of which 1.85 hours in REM sleep).

1.2. EVOLUTION OF SLEEP

Being asleep is risky for an animal in terms of being vulnerable to predators, so why has sleep evolved? The theories for the evolution and function of sleep can be divided into:

- Immobilisation during darkness;
- To conserve energy;
- To restore the body and aid physiological processes like cell growth;
- To aid the brain in consolidating learning and memory.

(Source: Esv)

Figure 1.1 - Brown-throated three-toed sloth.

The first main theory proposed for the evolution of sleep was the "immobilization hypothesis" (Meddis 1975).

Sleep evolved as an effective way to keep animals safe when not engaged in other activities or threatened by predators. After the animal has fed for the day, what to do in the remaining hours (particularly during darkness)? Moving around aimlessly uses energy (which requires more food), but also increases the chance of meeting a predator.

For this theory, sleep has no restorative function, and simply fills the (darkness) time. The need for "core sleep" has challenged this idea (Horne 1988). However, animals do sleep for longer in the winter and for shorter periods in the extended daylight of summer.

Another challenge to the "immobilization hypothesis" is "sleep rebound" after a period of sleep deprivation (Rechtschaffen 1998)(table 1.1). So "remaining very quietly awake would seem to be safer than sleep, especially if sleep is an optional activity" (Lima et al 2005 p726).

ARGUMENTS FOR	ARGUMENTS AGAINST
1. Good way to pass darkness time. 2. Good way to conserve energy. 3. Sleep length varies with daylight hours.	1. Not able to detect predators compared to quiet wakefulness. 2. Animals deprived of sleep catch up on their sleep when given the opportunity (rebound). 3. Animals appear to need "core sleep" irrelevant of the risks and activities.

Table 1.1 - Key points for and against the immobilization hypothesis.

Lima et al (2005) developed on the immobilization hypothesis by suggesting that a certain amount of sleep is necessary for restoration as well. Thus a period of "blackout" gives restorative benefits that quiet wakefulness could not. The need for sleep can be linked to the periods of REM sleep, which carry a high risk in terms of loss of muscle tone. During REM sleep animals must lay down which makes larger animals especially vulnerable to predators.

The trade-off between the need for sleep and the risk of vulnerability can be seen in changes in sleep behaviour by animals at higher risk of predation. Experiments have varied the apparent risk of a predator and the sleep behaviour has then been measured. For example, Lendrem (1984) presented, briefly, a ferret (Mustela putorius)(predator) to caged barbary doves (Steptopelia isoria). The doves subsequently showed more interrueptions in sleep ("peeking" to scan the environment) and less overall time sleeping compared to a control group without the predator.

Rattenborg et al (1999) performed a similar experiment with mallard ducks (Anas platyrhynchos) sleeping in groups of four (either in centre or on periphery). Those ducks sleeping on the periphery of the group in risky situations had twice as long in unihemispheric sleep and half as long in bihemispheric sleep compared to ducks sleeping in the centre.

The timing of sleep can also change in response to predators. Fenn and MacDonald (1995) noted the switch from day sleeping (and nocturnal activity) to night sleeping (and diurnal activity) by free-living rats in response to changes in behaviour by their predator, red foxes (Vulpes vulpes). This is evidence for a "tailoring-of-sleep" hypothesis (Lima et al 2005).

Overall, a trade-off can be seen between the amount of the brain ("neural units") "turned off" in sleep (ie: not aware of predators) and the restorative function of being "turned off" (Lima and Rattenborg 2007). Using the analogue of computers off-line, Lima and Rattenborg (2007) argued that full sleep (all units turned off) is more efficient than partial sleep:

> Partial sleep, during which a subset of units goes offline, might seem to be a better and safer option. However, interconnected functionality between neural units means that the brain functions disproportionately more poorly as more units go offline for maintenance. Furthermore, partial sleep can be a prolonged affair as time is needed to cycle through maintenance for all neural units. A prolonged period of less-than-effective anti-predator functionality may not be a favoured solution. Thus, the overall safest way to sleep is often to have all neural units offline and engaged in maintenance at the same time (Lima and Rattenborg 2007 p194).

One possibility is that sleep evolved because it reduces energy expenditure more than quiet wakefulness including body temperature reduction (Berger 1975). This fits an idea that sleep evolved for energy conservation specifically. Different species provide evidence for and against this hypothesis (table 1.2).

EVIDENCE FOR	EVIDENCE AGAINST
Animals with low nutrition diets that sleep for long periods; eg: koala over 14 hours sleep per day (Lee and Martin 1990).	Animals that are continuously moving; eg: dolphins (Pilleri 1979).

Table 1.2 - Examples of species for and against sleep as energy conservation.

Zepelin et al (2005) preferred to see sleep as keeping energy expenditure at an affordable level. So smaller animals with high metabolic rates sleep for long periods because their energy expenditure is great and they have limited fat reserves (eg: hamster have 14 hours sleep daily). Larger mammals have greater fat reserves and thus require less sleep to save energy (eg: elephants sleep four hours a day).

The evolution of REM sleep is another issue. REM sleep could be linked to brain development in newborns and maturity at birth. Species born fairly mature (precocial; eg: guinea pig) have low levels of REM sleep in newborns compared to altricial species (born immature), like rats and cats (Jouvet-Mounier et al 1969)(table 1.3).

SPECIES	NEWBORN	ADULT
Guinea pig (precocial)	15	5
Rat (altricial)	95	15

Table 1.3 - REM sleep as a percentage of total sleep.

The degree to which a species is altricial or precocial is measured on a four-point scale (Eisenberg 1981)(table 1.4).

ALTRICIAL			PRECOCIAL
1	2	3	4
Eyes closed; naked; rolls; sometimes can cling			Eyes open; furred; can walk and follow or swim

(After Zepelin et al 2005)

Table 1.4 - Scale for measuring altricial and precocial species at birth.

So REM sleep evolved to aid in post-birth development: "REM sleep could be considered a carryover from fetal life" (Zepelin et al 2005 p99). This fits with an idea that REM sleep is evolutionary distinct in birds and mammals from reptiles, and not evolved from reptile ancestors ("stem reptiles"), and is related to endothermy (Zepelin et al 2005). This is the maintenance of a high, constant body temperature by internal means, whereas reptiles tend to be dependent on the environment to control body temperature.

An alternative explanation for REM sleep is that it stimulates the brain in unconsciousness to aid recovery from sleep (Vertes 1986). This is also known as the "sentinel hypothesis" (Snyder 1966).

1.3. SLEEP IN BIRDS

Birds show four different sleep postures of which the first two are most common (Wellmann and Downs 2009):

i) "Back sleep" - the bill tucked under or on the scapula feathers;

ii) "Front sleep" - the head and the neck stationary with the bill pointing forwards and the eyes closed;

iii) "Bill on the back sleep" - the bill lies on the bird's back;

iv) "Head on the ground sleep" - the bird lies on the ground.

Wellmann and Downs (2009) investigated sleep in three southern African birds - malachite sunbirds (Nectarinia famosa)(figure 1.2)(n = 10), cape white-eyes (Zosterops virens)(figure 1.3)(n = 8) and fan-tailed widowbirds (Euplectes axillaris)(n = 8).

During sleep these birds face the problems of body temperature drop and predators. Roosting high in trees avoids ground-based predators in the latter case. Each species has a different way of dealing with the former (table 1.5).

SPECIES	FOOD	SLEEP
Malachite sunbird	nectar	body temperature drops to conserve energy
Cape white-eye	insects, fruit	huddle in pairs
Fan-tailed widowbird	seeds	large flocks

Table 1.5 - Three species of birds studied by Wellmann and Downs (2009).

(Source: Claudia Gibney Finch-Davies; in public domain)

Figure 1.2 - Drawing of malachite sunbird.

(Source: Claudia Gibney Finch-Davies; in public domain)

Figure 1.3 - Drawing of Cape white-eye.

The captured birds were individually recorded by remotely controlled infrared-sensitive cameras between 1800 and 0600 hours in darkened cages. The temperature of the cages was varied between 5°C and 25°C.

All three species of birds used back and front sleep, but the amount varied depending on the cage temperature. In the lower temperature, more time was spent in back sleep (eg: 83% vs 58% at 25°C for malachite sunbirds) as this posture reduces heat loss (table 1.6). Unihemispheric sleep with one eye open was recorded in cape white-eyes only.

BIRD	BACK SLEEP AT 5°C	BACK SLEEP AT 25°C	FRONT SLEEP AT 5°C	FRONT SLEEP AT 25°C
Malachite sunbird	83	53	17	47
Cape white-eyes	98	30	2	70
Fan-tailed widowbirds	no data	12	no data	88

Table 1.6 - Mean percentage of sleep time in two sleep postures.

The need for sleep is challenged by migratory birds that appear to survive with little or no sleep during migration. Rattenborg et al (2004) studied twice-yearly nocturnal migrating White-Crowned sparrows (Zonotrichia leucophrys gambelii)(figure 1.4) captured in Alaska, USA. These birds travel 4300 km there and back between Alaska and California in March-June and August-October. Outside of migration, these birds are active during the day and sleep at night.

In captivity, "migratory restlessness" (Zugunruhe) is shown by hopping and wing flapping at night. An infrared beam is put across the cage, and when this is broken it shows that the bird is active at night. Video recording also showed the birds flapping their wings while on the perch as if attempting to initiate flight.

Adult birds were surgically fitted with electrodes to allow EEG recordings and thus distinguish wakefulness, drowsiness, SWS, and REM sleep. Each of these states produces different amplitude and frequency of electrical activity in the brain. Representative 24-hour periods were recorded for the caged birds during and prior to migration season.

To see the effects of prolonged sleeplessness, the birds' recall of a series of key pecks to gain food (repeated acquisition procedure) was measured. This involved learning of three-key response sequence of left-right-centre, for example, which was rewarded with five-second access to mixed seed every third correct response (fixed ratio reinforcement = 3) or a 5-second time-out when wrong.

(Source: US Fish and Wildlife Service)

Figure 1.4 - White-Crowned sparrow.

The five non-migratory sparrows showed an unchanging pattern of sleep (33.8% of 24-hour period), drowsiness (17.9%), and wakefulness (48.3%). The eight migratory birds showed a reduction in sleep during the migration season to 12.5% of the 24-hour period, but increases in drowsiness (25.7%) and wakefulness (61.7%). In one bird, sleep time decreased from over nine hours per night outside the migration season to 1.5 hours on migration nights.

Any sleep in the migratory birds tended to be in the first few hours of darkness, and REM sleep occurred earlier in the sleep period (before midnight) than in non-migratory birds (10 minutes vs 24 minutes after sleep onset). Overall, however, the total amount of time in REM sleep did not vary (16.3% for non-migratory birds and 14.8% for migratory birds).

Despite the reduction in sleep, the migrating birds performed as well on the key pecks task, while the non-migratory birds showed a decline in performance (less accuracy and number of responses) with forced sleep deprivation (3 hours per night for three nights).

From this laboratory study, it seems that that nocturnal migrating birds do not sleep during flight, but their cognitive abilities, like navigation, are unimpeded. However, it could not be ruled out that the sparrows sleep during flight because unobstructed nocturnal flight only requires brief awakenings for navigational purposes.

This was a laboratory study with invasive EEG recording which is different to the naturalistic study with sloths (Rattenborg et al 2008)(table 1.7).

SPARROWS (Rattenborg et al 2004)	SLOTHS (Rattenborg et al 2008)
• 8 birds aged 13-14 months • Anaesthesia used during operation • 4 small holes drilled in skull and electrodes glued into place • Lightweight recording cable attached to electrodes • 10 days of post-operative recovery • Laboratory study in cages	• 3 adult females (exact ages unknown) • Anaesthesia during procedure • 7 fine wire electrodes inserted through skull with hypodermic needle connected to Neurologger2 recorder glued to head • Battery-operated • weight 11g • Animals in own habitat

Table 1.7 - Comparison of EEG recording in studies with sparrows and sloths.

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1.5. APPENDIX 1

McNamara et al (2008) reported the construction of the Phylogeny of Sleep Database with information about sleep in mammals (http://www.bu.edu/phylogeny). They collected 178 papers detailing 127 mammal species, of which 73 species have been studied for both REM and NREM sleep.

Among adult mammals the average is 11.7 hours sleep per day (average 17% of which is REM). The duck-billed platypus (Ornithorhynchus anatinus) spends 40% of sleep time in REM.

The least sleep per day is three hours in the ass (Equus asinus), and the most is the armadillo (Chaetophractus villosus) with 20 hours per day. Sleep cycles vary from six minutes in the chinchilla (Chinchilla laniger) to 60 mins in horses (Equus caballus). Table 1.8 lists some examples of daily sleep from the database.

SPECIES	TOTAL DAILY SLEEP (hours) *
• Ass	3
• Cat/Laboratory cat	6-13 /12-13
• Cheetah	12
• Chimpanzee	10-14
• Cow	2-4
• Dog	13
• Elephant	4-8
• Giraffe	2-4
• Laboratory mouse	12
• Rhesus monkey	9-12
• Seal	7-18
• Sheep	5
• Squirrel	13-16

(* Figures are whole hours; range = number of different studies; not all sleep taken at one time in 24 hour period)

(Source: Phylogeny of Sleep Database; accessed 11/7/09)

Table 1.8 - Examples of total daily sleep in different mammals.

2. A STUDY OF SLEEP PARALYSIS IN JAPAN - KANASHIBARI

2.1. Introduction
2.2. Arikawa et al (1999)
2.3. Evaluation
2.4. References

2.1. INTRODUCTION

"Kanashibari" is a Japanese term for "isolated sleep paralysis" [1] where a sufferer "cannot move upon awakening and often hallucinate that an intruder is entering the room and sitting or lying on top of them; the result is often intense fear or anxiety" (Arikawa et al 1999 pp369-370). Just under half (43%) of Japanese students questioned reported at least one episode in their lives (Fukuda et al 1987).

2.2. ARIKAWA ET AL (1999)

Arikawa et al (1999) looked at the parameters of kanashibari with a varied sample of 720 Japanese individuals including students, nurses, those in business, and housewives. They were asked: "When you woke up from sleep or in falling asleep, have you ever not been able to move?".

The respondents were asked further questions related to:

- Death anxiety using the 15-item true or false Death Anxiety Scale (Templer 1970); eg: "I am really scared of having a heart attack"; "The thought of death seldom enters my mind".

- Locus of control with the Brown Locus of Control Scale (Brown 1990). This measured the extent to which individuals feel in control of their lives (internal locus of control) or feel that their lives controlled by other people (external-social locus of control) or chance/God (external-other locus of control).

Two hundred and forty-four (33.9%) respondents said they have experienced at least one episode of kanashibari in their lives. The median number of episodes was three with a range of one to fifty. The main symptoms reported were unable to speak (81%), feeling pressure on the body

[1] Sleep paralysis is usually seen as part of the sleep disorder, narcolepsy. If it occurs in non-sufferers of narcolepsy, it is classed as "isolated sleep paralysis" (Arikawa et al 1999).

(70.2%), saw or heard something that was not there (38.4%), had difficulty breathing (41.6%), and were anxious and fearful (35.8%).

Some of the variables were significantly correlated with a history of kanashibari and some were not. A high score on the Death Anxiety Scale, and an external-other locus of control of the Brown Locus of Control Scale positively correlated with kanashibari (table 2.1).

SIGNIFICANT CORRELATION	NON-SIGNIFICANT CORRELATION
• Female (+0.15)(p<0.001) • Death anxiety (+0.14)(p<0.001) • External-other locus of control (+0.11)(p<0.01)	• Educational level (-0.14) • High blood pressure (+0.02) • Religious beliefs (-0.01) • Internal locus of control (+0.05) • External-social locus of control (+0.04)

Table 2.1 - Significant and non-significant correlations for a history of kanashibari.

Specific symptoms of kanashibari were also significantly correlated with particular variables (table 2.2).

VARIABLE	SYMPTOM
• External-other locus of control	• Breathing difficulty (+0.15) • Supernatural attribution of experience (-0.14)
• Female	• Unable to speak (+0.14) • Feeling pressure on body (+0.18) • Breathing difficulty (+0.16)
• Religious beliefs	• Breathing difficulty (+0.19)

Table 2.2 - Significant correlations between variables and symptoms of kanashibari.

Overall, those who experienced kanashibari had less "self-initiated power over their environment" than those who did not experience it. Note that women in Japanese society are seen as having less power over the environment than men, and than women in the West.

2.3. EVALUATION

This study can be evaluated in a number of ways.

1. Sample - varied background, quite large, and non-clinical with an age range from 15 to 81 years. Only 33 respondents were students whereas Fukada et al (1987) was based entirely on them.

But the gender division was not equal - 57.2% were women, 37.2% were men, and 5.6% did not specify their gender.

2. Questionnaires used to measure variables - two standardised questionnaires were used to measure death anxiety and locus of control with established test-retest reliability of 0.83 and 0.81 - 0.91, and internal reliability of 0.76 and 0.66 - 0.74 respectively [2].

3. General problems with questionnaires - self-reported questionnaires depend upon the honesty of the respondents as well as their accuracy of recall. For example, questions like "How many times did you have this sort of experience?" and "How old were you when you had the first experience?" can be influenced by memory errors. While questions like "Were you anxious or fearful?" and "Do your parents or siblings have the similar experience?" are especially prone to socially desirable answers. Thirty-three respondents did not answer about their family - embarrassment or lack of information?

4. Design of the kanashibari questionnaire - the kanashibari questionnaire was in English and translated into Japanese and back to check for translation accuracy. Different individuals checked the accuracy of the translations.

The questionnaire involved ten forced-choice questions, and a final open-ended "Please describe your experience in your own words". This latter question will be influenced by the previous forced-choice questions, and it may have been better to put it first (McClendon and O'Brien 1988).

5. The terms used - the questionnaire did not use the term kanashibari, but operationalised it as not being able to move on waking. This can be interpreted in different ways, and not necessarily in the way the researchers wanted. This is the case with all questions.

[2] The Brown Locus of Control Scale has three scores for internal, external-social, and external-other locus of control.

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3. SLEEP AIDS SOME ASPECTS OF LEARNING OF SKILLS, BUT NOT OTHERS

3.1. INTRODUCTION

Skill learning involving learning how a movement is performed, and the goal of the movement. In the example of playing a piece of music on the piano, there is the learning of the musical notes and learning the appropriate sequence of finger movements. A skill is improved by practice and by consolidation. The latter is the "bedding down" of the memory.

This can be tested in the laboratory experiment by the procedural sequence learning task. These involve participants learning a sequence of buttons to press.

3.2. COHEN ET AL (2005)

Cohen et al (2005) used a particular type of such task called the serial reaction time task (SRTT). A visual cue appears in one of four places on the computer screen, and the participant must respond by pressing the appropriate button. Unbeknownst to the participant there is a pattern to the visual cues as in a finger sequence (eg: middle-little-ring), and of buttons to press (eg: 2-4-3).

The participants are trained with one hand and then tested with the other. The changing of hands was used to isolate the two components of skill learning. So the same sequence of response buttons requires a different set of finger movements. This is known as maintaining the goal but altering the goal configuration, and it tests the knowledge of the goal. On the other hand, the sequence of finger movements can be maintained but the response button sequence (movement configuration) is changed. This measures the knowledge of the finger movements (table 3.1).

Cohen et al (2005) recruited right-hand-dominant participants for four conditions. The participants were tested twelve hours after learning, which was either over night (with sleep) or over the day. Thus the four conditions were:

1. Night/goal-based skill - Trained at 8pm and tested the following day at 8am. The sequence of response buttons was 2-3-1-4-3-2-4-1-3-4-2-1, which was learned on the

TESTED	SAME	CHANGE
Knowledge of goal: knowledge of goal, independent of fingers used (goal-based learning)	Response buttons: 2-4-3	Finger sequence: Train right hand = middle-little-ring Test left hand = ring-index-middle
Knowledge of finger movements: knowledge of finger movements, independent of sequence of response buttons (movement-based	Finger sequence: middle-little-ring	Response buttons: Train right hand = 2-4-3 Test left hand = 3-1-2

Table 3.1 - Changing hands and what aspect of skill learning is being tested.

right hand and tested on the left hand (different finger movements);

2. Day/goal-based skill - Same task as condition 1, but trained at 8am and tested at 8pm on the same day;

3. Night/movement-based skill - Overnight group trained with finger sequence to response buttons 4-2-3-1-4-2-1-2-4-3-2-3, and tested with same finger sequence on left hand, which produced response button sequence 1-3-2-4-1-3-4-3-1-2-3-2;

4. Day/movement-based skill - Same task as condition 3, but over the day.

There were also two control conditions added which tested the two types of skills over 24 hours.
The response time was recorded as was the interval between presentation of the stimulus and selection of the correct response.

Cohen et al found significant differences in reaction time improvements over the 12-hour interval between training and testing depending on what happened in that interval. Goal-based skill improved only overnight (by an average of 35ms)(condition 1), and movement-based skill was better only over the day (by an average of 21ms)(condition 4).

Applying this finding to learning a piece of piano music, the appropriate sequence of finger movements improves with sleep, while the learning of the musical notes is better during the day.

3.3. REFERENCES

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4. SLEEP AND HEALTH

The relationship between sleep and health is bidirectional - "sleep disturbances contribute to the development of or increase the severity of various medical and psychiatric disorders, and these same disorders result in poor sleep quality" (Zee and Turek 2006 p1686). For example, individuals with less than five hours sleep per night have a three-fold greater risk of heart attacks (Liu and Tanaka 2002), while patients with coronary heart disease (CHD) reported more sleep disturbances than patients without CHD (Schwartz et al 1999).

While sleep apnea sufferers have an increased risk of cardiovascular disease, individuals with cardiovascular disease have higher risks of sleep apnea (Shahar et al 2001). An increase in sleep apnea can also produce an increased risk of depression (Peppard et al 2006).

Illness is a cause of enforced sleep loss, but voluntary sleep curtailment also affects health. Steptoe et al (2006) found that individuals with less than seven hours sleep per night (through choice) had higher chances of poor health in a survey of 17 465 university students in 27 countries.

It seems, but it is not clear how, that sleep loss has effects on the immune function (Zee and Turek 2006).

What aspects of sleep are linked to health problems or mortality? For example, Dew et al (2003) found that, after an average of twelve years follow-up, sleep latency (time to fall asleep) of more than thirty minutes produced twice the risk of death among elderly volunteers studied. Poor sleep efficiency (a lot of time in bed and little time asleep), and either high or low REM sleep as a percentage of total sleep were also risk factors, but not too little sleep.

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5. SLEEPING HABITS AMONG MEXICAN STUDENTS

5.1. INTRODUCTION

The amount of sleep that individuals have can vary between different groups as can the actual times of sleep. In some places, for example, daytime napping is common ("siesta culture"; Webb and Dinges 1989).

The sleeping habits of students have been studied because that group is often more accessible to researchers (and willing to take part in research).

5.2. VALENCIA-FLORES ET AL (1998)

Valencia-Flores et al (1998) investigated the sleeping habits of 577 undergraduates at the National Autonomous University of Mexico in Mexico City using a Spanish translation (Valencia-Flores et al 1994) of the Sleep-Wake Activity Inventory (SWAI)(Rosenthal et al 1993) and the Sleep Habits Questionnaire.

Six hundred and seventy-three students of psychology, medicine, and engineering volunteered to fill out the questionnaires, but only 85% completed them (thus n = 577) [3]. Respondents working night shifts or over 30 years of age were excluded.

The mean age was 20.23 years with the majority (86%) of the sample aged between 17-22 years. 54% of the respondents were female (n = 313).

The questionnaires were administered during classes in the morning. Nine items from the SWAI were used, which were situations where sleepiness might occur (eg: sitting in a comfortable chair), and they were scored between one ("always present") to nine ("never"). The Sleep Habits Questionnaire measured sleep schedule on workdays and days off, and number of hours of sleep, naps taken, and beverages and prescription drugs taken over the last seven days (box 5.1).

[3] Forty male and 56 female respondents were not included in the analysis.

The questionnaire designed by Valencia-Flores et al (1998) has nine sections:

- Preliminary information - eg: age, sex; height/weight.
- A - hours of employment.
- B - sleep schedule; eg: "go to bed at".
- C - average number of hours slept. This is asking respondents to estimate the number of hours and minutes asleep (not including awake in bed), and such estimates are quite difficult. Then they are asked "do you get enough sleep at night?". The perception of being asleep, and how much sleep is required are not necessarily accurate.
- D - naps taken.
- E - snoring.
- F - list of beverages.
- G - smoking habits.
- H - prescription drugs taken.

Box 5.1 - The Sleep Habits Questionnaire.

5.3. RESULTS OF VALENCIA-FLORES ET AL (1998)

1. Amount of sleep

The majority (65%) reported an average between 6.5 - 8.5 hours of sleep per night with a range of less than 5.5 hours (1.7%) to greater than 9.5 hours (6.1%).

Sleep length on off-days/weekends was longer than workdays, and this was most prominent for short average sleepers. For example, those whose average was less than 5.5 hours per night had an average of eight hours during weekends, but this was still less than the other groups (table 5.1). "This implied that whatever compensatory increase in sleep that occurs at weekends takes place in the context of each individual's customary sleep quota" (Valencia-Flores et al 1998 pp22-23). Increased sleep at weekends was also found by Machado et al (1998) (appendix 2).

MEAN HOURS OF NIGHT-TIME SLEEP DURING WEEK (hrs)	PERCENTAGE OF TOTAL SAMPLE	MEAN HOURS OF NIGHT-TIME SLEEP DURING WEEKEND (hrs)
<5.5	1.7	8.32
5.5 - <6.5	10.7	8.47
6.5 - <7.5	28.6	8.83
7.5 - <8.5	35.4	9.47
8.5 - <9.5	17.5	10.36
>9.5	6.1	11.13

(After Valencia-Flores et al 1998)

Table 5.1 - Mean hours of sleep of sample.

2. Naps

34% of respondents reported napping during the day, and this did not vary with amount of night-time sleep; eg: 20% of short sleepers napped compared to 30% of medium sleepers and 31% of long sleepers. There was no gender difference.

3. Sleepiness and sleep-wake cycle

The respondents were divided into four groups:

- A - average less than 7.5 hours sleep, but regular sleep schedule;
- B - average greater than 7.5 hours sleep, but regular sleep schedule;
- C - average less than 7.5 hours sleep, but irregular sleep schedule (a difference of two hours or more in wake-up time between workdays and weekends);
- D - average greater than 7.5 hours sleep, but irregular sleep schedule.

Group A reported the highest level of sleepiness and group B the lowest level.

4. Sleep satisfaction

56% of respondents reported satisfaction with night-time sleep, and satisfaction increased with average length. Napping or not had no relationship to sleep satisfaction.

5. Beverages and tobacco

No correlations between caffeine intake, alcohol use, smoking and level of sleepiness, and amount of sleep.

Table 5.2 compares the findings from this study with other students around the world. Overall "the elements of convergence outweigh occasional differences which can be noted between the Mexican population and other populations" (Valencia-Flores et al 1998 p26).

Table 5.3 compares the strengths and weaknesses of the Valencia-Flores et al (1998) study.

SLEEP BEHAVIOUR	OTHER STUDIES
Total sleep time (7-8 hours)	• 7.36 hours among 532 US psychology undergraduates (Bousfield 1940) • 7.93 hours among psychology undergraduates in California (Hawkins and Shaw 1992) • 7.98-8.07 hours among 17-year old Canadian students (Levy et al 1986) • 7.3-8 hours among Australian medical students (Johns et al 1971)
Sleep schedule (sleep at 22.63-24.05 until 05.27-08.23)	• Similar to UK, Sweden, Australian • Difference to USA and Icelandic students who sleep later
Naps (one-third of respondents)	• Nearer 3/4 of US students (Lawrence and Shurley 1972) • 20-44% high school students in Sao Paulo, Brazil (Andrade et al 1993)

Table 5.2 - Comparison of sleeping habits of Mexican students and examples of other student groups [4].

STRENGTHS	WEAKNESSES
1. Reasonably large sample. 2. Use of standardised questionnaire (SWAI). 3. Removal of respondents who worked night shifts. 4. Homogeneous group in terms of age and social background. 5. Students tended to live at home, so typical behaviour measured.	1. Individuals who volunteer are not typical of the population as a whole. 2. Only psychology, medical, and engineering students used. 3. Questionnaires depend upon the honesty and accuracy of respondents' answers. 4. Weakness of Sleep Habits Questionnaire (see box).

Table 5.3 - Strengths and weaknesses of the Valencia-Flores et al (1998) study.

5.4. APPENDIX 2 - MACHADO ET AL (1998)

Machado et al (1998) gave ninety-five female undergraduates in Sao Paulo state, Brazil a questionnaire about many aspects of their sleep habits. The students either attended classes in the morning (0730 - 1130) or in the evening (1930 - 2330). Availability of students

[4] Hawkins and Shaw (1992) asked 67 psychology students at San Jose State University to keep seven-day sleep logs on three occasions over the term. "Time in bed" declined over the term from 8.05 hours to 7.82 hours by the third log.

allowed the division of the evening group into job and no job.

The amount of sleep varied between each group, and between weekdays and weekends (table 5.4). The students who attended evening classes and had no jobs had the most regular sleep schedule with little difference between sleep length between weekdays and weekend (table 5.5). Large changes in sleep schedule between weekdays and weekends, as with the other two groups, was associated with poorer quality sleep as rated subjectively and by spontaneous awakenings in the morning (table 5.6).

	MORNING CLASSES	EVENING CLASSES - NO JOB	EVENING CLASSES - JOB
WEEKDAY - BEDTIME WAKE UP	22.52 06.16	24.21 08.46	24.25 07.07
WEEKEND - BEDTIME WAKE UP	01.20 09.55	01.50 10.21	24.07 09.46
SIGNIFICANCE	<0.001; both bedtime and waking time between weekday	<0.001; both bedtime and waking time between weekday	<0.001; later waking time at weekends

(After Machado et al 1998)

Table 5.4 - Mean bedtime and waking times of students.

	MORNING CLASSES	EVENING CLASSES - NO JOB	EVENING CLASSES - JOB
NUMBER IN GROUP	47	31	17
WEEKDAY (hrs)	7.40	8.40	6.70
WEEKEND (hrs)	8.58	8.50	9.67

(After Machado et al 1998)

Table 5.5 - Mean sleep length of students.

	MORNING CLASSES	EVENING CLASSES - NO JOB	EVENING CLASSES - JOB
RATED VERY GOOD SLEEP QUALITY (%) - WEEKDAYS WEEKENDS	 24 43	 25 59	 20 56
SPONTANEOUS AWAKENINGS - WEEKDAYS WEEKENDS	 15 * 87	 52 77	 53 94

(* = p<0.001 to other two groups)

(After Machado et al 1998)

Table 5.6 - Subjective and objective measures of sleep quality.

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6. AWAKE OR ASLEEP?

Individuals who suffer from insomnia report hours of not sleeping. But studies in sleep laboratories with physiological measures of sleep have shown that individuals are inaccurate in sleep perception. For example, Moore et al (1981) woke individuals after a few minutes of sleep (as measured by EEG), and 83% of insomniacs and 50% of healthy controls reported that they were awake. In extreme cases, a small number of individuals report being awake when woken from deep sleep (Attarian 2007).

Semler and Harvey (2005) led insomniac students to believe that they had a bad night's sleep when they had not. These students showed behaviour as if they had not slept well (eg: negative thoughts, feeling sleepy). The researchers argued that it is the anxiety about not sleeping well that can be as important as actually not sleeping well for some insomniacs.

The misperception of sleep has been classified as "Paradoxical Insomnia" in the "International Classification of Sleep Disorders" (American Academy of Sleep Medicine 2005). The sufferer reports insomnia without objective evidence of sleep deprivation (eg: daytime sleepiness).

There is the existence, in even rarer cases, of the opposite - the misperception of wakefulness as sleep (Attarian et al 2004). EEG recordings show that sufferers are awake, but they report being asleep. This has been called "Perception of Wakefulness Disorder" (Attarian 2007) or "asymptomatic insomnia" (Schneider-Helmert 2007).

The debate is whether these two conditions are at either end of a spectrum or separate conditions. In the first case, both conditions are most common in individuals with other sleep, psychiatric, and medical problems. On the other hand, the conditions respond differently to drug treatment. The misperception of individuals with paradoxical insomnia does not change despite improvements in sleep whereas the misperception in asymptomatic insomnia does improve with drug treatment (Attarian 2007).

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7. LUCID DREAMS AND THE EARLY WORK OF STEPHEN LABERGE

7.1. INTRODUCTION

"Lucid dreaming" is a term used to describe the relatively rare situation where dreamers are able to realise they are dreaming, and to "consciously" think within the dream, like controlling the narrative of the dream (Green 1968). "During such 'lucid' dreams, one can reason clearly, remember the conditions of waking life, and act upon reflection or in accordance with plans decided upon before sleep. These cognitive functions, commonly associated only with waking consciousness, occur while one remains soundly asleep and vividly experiencing a dream world that is often nearly indistinguishable from the 'real world'" (LaBerge 2000 p962).

Many sleep researchers, like Hartmann (1975), rejected lucid dreaming as "brief arousals" or "micro-awakenings". But Stephen LaBerge has been one of the foremost advocates of lucid dreaming [5] as part of REM (rapid eye movement or dream) sleep and not awakenings.

LaBerge et al (1981) established that lucid dreaming occurred during objectively measured REM sleep (figure 7.1 [6]). The sleep of participants was recorded for a total of 34 nights. The participants were taught to signal the onset of lucid dreaming by eye movements [7], which were observable on physiological recordings [8]. An independent judge was able to determine the onset of lucid dreaming in 90% of cases with five participants.

Where sleepers can signal the onset of lucid dreaming, and it is recorded on the physiological measures, this is known as "signal-verified lucid dreams" (SVLDs). LaBerge et al (1986) analysed the physiological data from thirteen participants producing 76 SVLDs. 92% of cases were unequivocally during REM sleep and most occurred during REM later in the night's sleep.

The lucid dreams were initiated in two ways - the

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[5] He set The Lucidity Institute to further research (http://www.lucidity.com/).
[6] Figures 7.2, 7.3 and 7.4 show measures for three stages of non-REM sleep.
[7] During REM sleep most voluntary muscles are inhibited, and eye muscles are an exception.
[8] This was first performed in a sleep laboratory by lucid dreamer Alan Worsley (Hearn 1978 quoted in Blackmore 1991).

realisation that a dream is a dream (dream-initiated lucid dreaming; DILD) or briefly waking before entering the dream (wake-initiated lucid dreaming; WILD). The former were more common (72% of cases).

7.2. DREAM EXPERIMENTS

The study of lucid dreaming depends upon the dreamer being able to signal their awareness to the researchers. This allows for "dream experiments" (LaBerge 1980). For example, the perception of time during dreaming compared to actual time passing. Participants were asked to estimate ten-second intervals (by counting "one thousand and one", one thousand and two", and so), and signal with eye movements. Time estimates were similar to actual time passing (LaBerge 1990).

LaBerge (1990) reported that gaze shift in lucid dreaming correlates with physiologically recorded eye movements. Two participants were asked to follow the slow movement of their finger across their visual field from left to right when: (i) awake (eyes open), (ii) awake (eyes closed and imagining), (iii) lucid dreaming, and (iv) imagining lucid dreaming ("dream eyes closed"). Conditions 1 and 3 showed similar patterns of eye movement, as did conditions 2 and 4.

LaBerge and Dement (1982a) asked three lucid dreamers to alter their breathing during lucid dreaming - either speed up or hold breathe. An independent judge was able to distinguish these behaviours from physiological measures.

LaBerge and Dement (1982b) compared the electrical activity in each hemisphere of the brain in participants "dream singing" or "dream counting" during lucid dreaming. The right hemisphere was more active in the former, and the left for the latter. This pattern is similar to performing those activities awake, but not awake individuals imagining the activity.

Different techniques have been used to induce lucid dreams including tape recordings of the phrase. "This is a dream", light, touch, or smells, with light being the most promising of them (LaBerge 1990).

Table 7.1 weighs up the strengths and weaknesses of LaBerge's early research on lucid dreaming.

STRENGTHS	WEAKNESSES
1. Showed that sleep and dreaming is complex and that "there are degrees of being asleep" (LaBerge 1990). 2. Able to gain an insider's view on dreaming and sleep. 3. Able to perform "dream experiments".	1. Some sleep researchers still question the nature of lucid dreaming. 2. Lucid dreaming is relatively rare: less than one-fifth people regularly (LaBerge 1990). 3. Many of the experiments involved small numbers of participants.

Table 7.1 - Strengths and weaknesses of LaBerge's early research on lucid dreaming.

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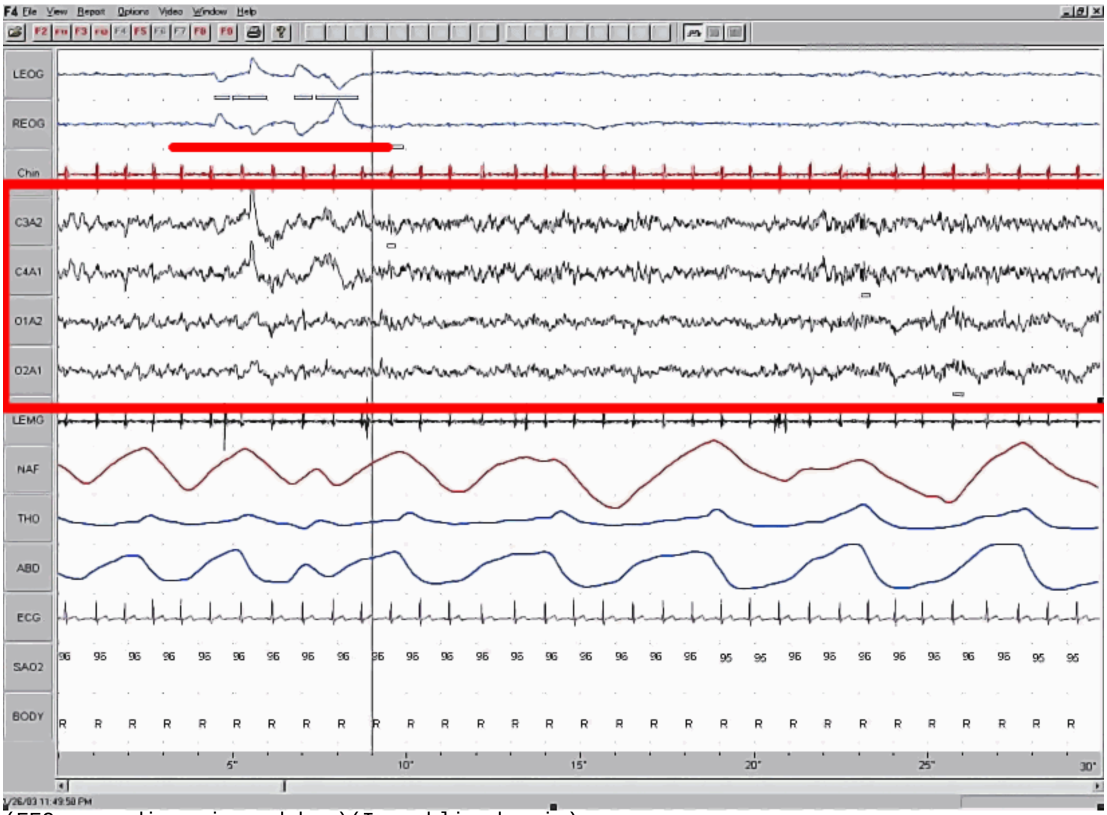
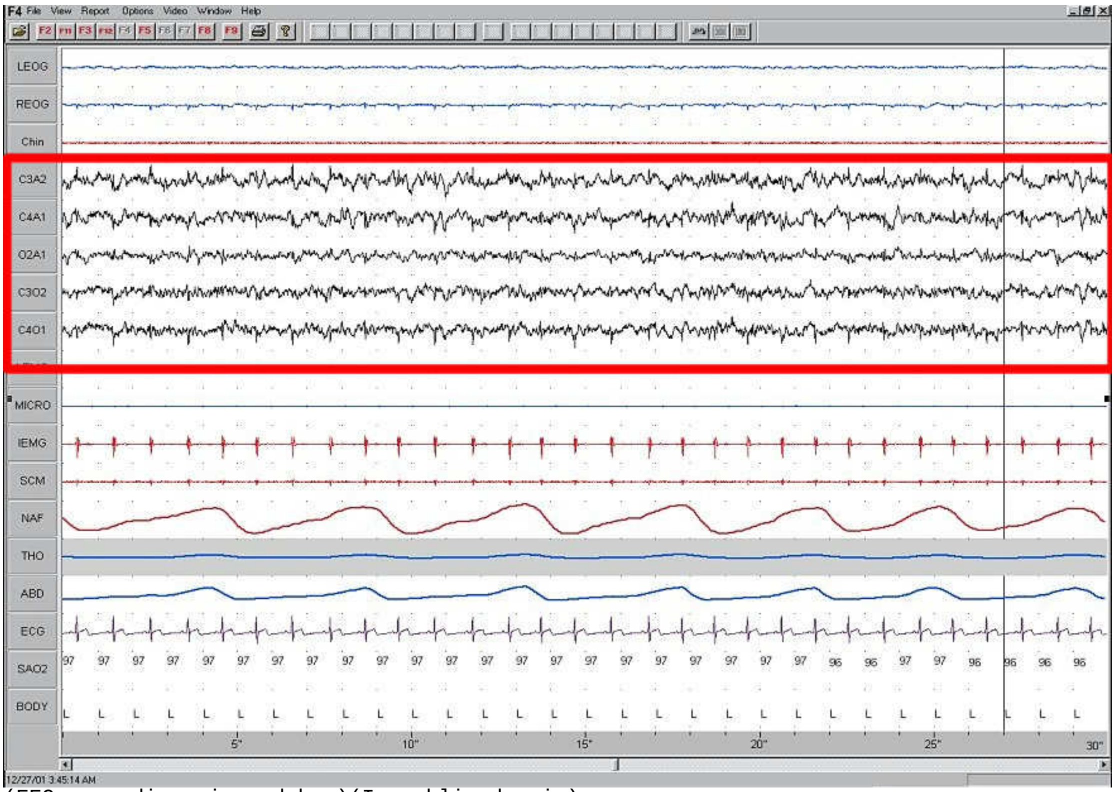


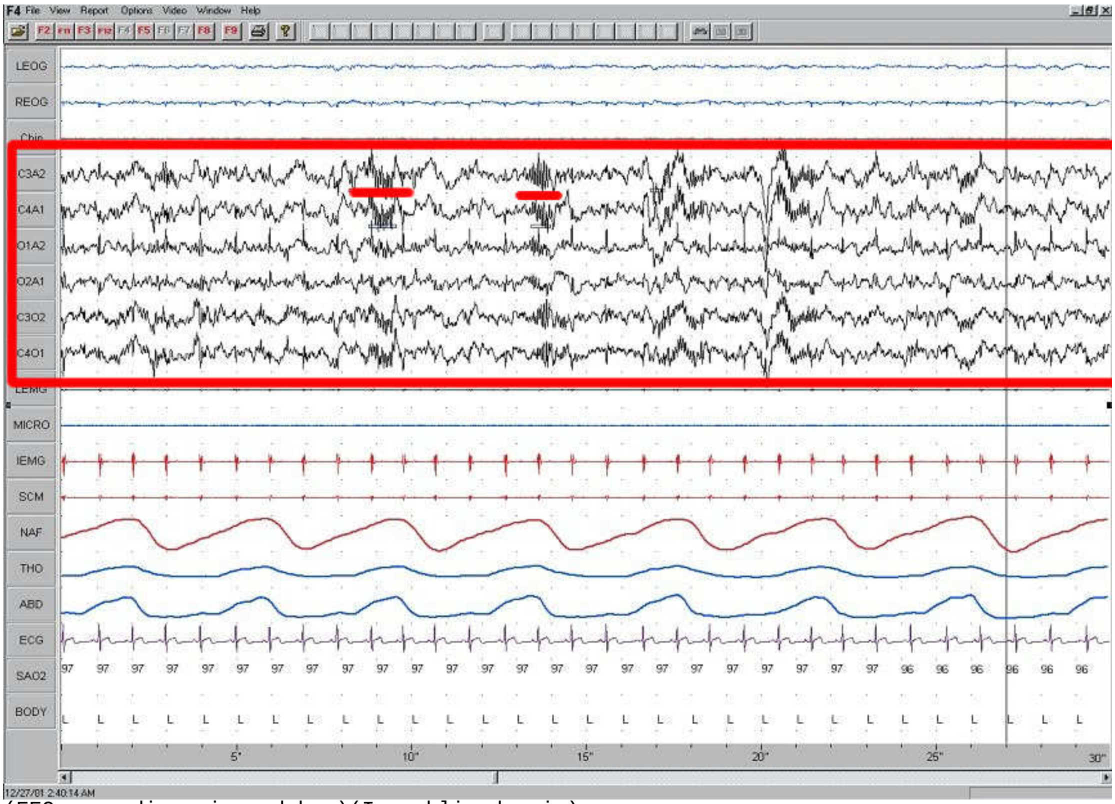
(EEG recordings in red box)(In public domain)

Figure 7.1 - Polysomnographic recording of thirty seconds of REM sleep.



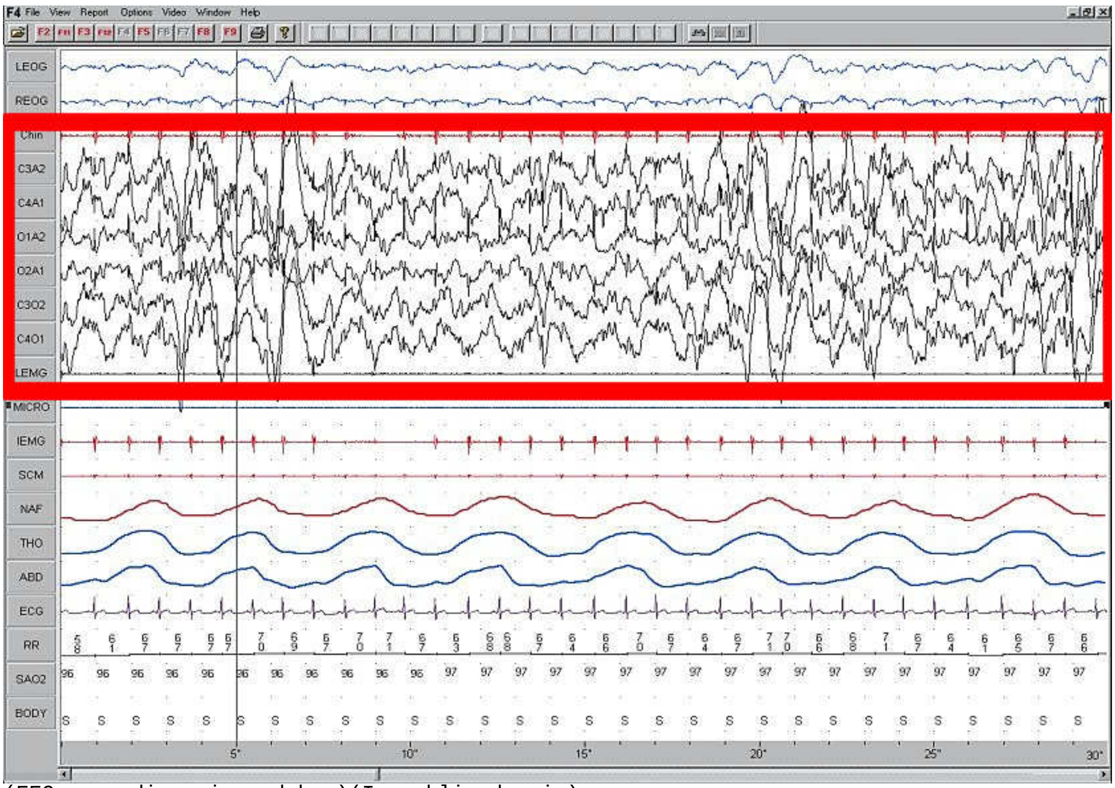
(EEG recordings in red box)(In public domain)

Figure 7.2 - Polysomnographic recording of thirty seconds of stage 1 NREM sleep.



(EEG recordings in red box)(In public domain)

Figure 7.3 - Polysomnographic recording of thirty seconds of stage 2 NREM sleep.



(EEG recordings in red box)(In public domain)

Figure 7.4 - Polysomnographic recording of thirty seconds of stage 4 NREM sleep.

8. HOW MUCH SLEEP IS AVERAGE?

8.1. INTRODUCTION

What is normal sleep varies from one individual to another, but surveys can give a general picture of the sleeping habits of the population. However, because they are usually self-reported questionnaires, they rely on the accuracy and honesty of answers.

There are many surveys of sleep, but here are two examples - one from the USA and one from the UK.

8.2. USA SURVEY

Lauderdale et al (2006) studied the sleep behaviour of 669 US adults in the Coronary Artery Risk Development in Young Adults (CARDIA) study. This study began in 1985-6 with a group of 18-30 year olds (Friedman et al 1988). The data were collected for this sleep study in Year 15 (33-45 years old) at the Chicago site of four.

For three nights participants wore an "Actiwatch" (a wristwatch which measures movement) and kept a sleep diary of time to bed, sleep latency (how long to fall asleep), total sleep duration, and sleep efficiency (ratio of sleep duration to time in bed [9]). Table 8.1 summarises the main findings from both measurements.

ACTIGRAPHY DATA: • Time in bed • Sleep duration • Sleep efficiency • Sleep latency	 7.51 hours 6.06 hours 80.8% 22.33 minutes
SELF-REPORTED DATA: Sleep duration • Weekdays • Weekends	 6.65 hours 7.26 hours

(After Lauderdale et al 2006)

Table 8.1 - Main findings of Lauderdale et al (2006).

[9] A high percentage means most of the time in bed is asleep while a low percentage is a lot of time on bed and little sleeping.

Lauderdale et al analysed the data by social variables:

- Ethnicity - White participants had better sleep than Blacks (eg: longer and quicker to sleep);

- Gender - Women better sleep than men;

- Ethnicity and gender - White women had the most sleep (average 6.71 hours), then White men (6.09), Black women (5.90), and, finally, Black men (5.10 hours);

- Income - Higher income individuals had better sleep efficiency, and longer sleep duration with shorter sleep latency.

8.3. UK SURVEY

Horne (2007) used volunteers who listened to BBC Radio Four's programme, "Today", as the sample. There were 4893 respondents, most in the age range 40-60 years old. This is a good general overview of sleeping habits among adults in the UK, though it is not representative of the population as a whole (eg: more educated respondents).

- Sleep onset - 2330 (mode) with 1.5% of respondents before 2200 and 1% after 0200.

- Waking - 0700 (mode; 78% of respondents).

- Sleep duration - Mean for males was 6.9 hours and 7.2 hours for females. Only 8% of people slept more than eight hours.

- Ideal sleep - 66% of respondents wanted between 7-8 hours per night with men wanting 28 minutes more on average and women another thirty minutes.

- Insomnia - 26% of female and 18% of male respondents felt they had insomnia more than twice a week.

8.4. REFERENCES

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8.5. APPENDIX 3 - WEB ACTIVITY

Are we sleeping less today than in the past? The common assumption is yes for industrialised and Western countries.

A general search on the Internet produces information that sleep in 1900 in the USA was nine hours (eg: http://news.bio-medicine.org/medicine-news-3/New-study-shows-people-sleep-even-less-than-they-think-3941-1/). This tends to be passed around as fact, but what is the source for it? Is it accurate?

A historical study of working hours in London by Voth (1997, 2001) stated that average sleep was 7 hours 27 minutes in 1750-63, and declined to 6 hours 35 minutes in 1800.

What were the average hours of sleep in the past - 1950, 1900, 1800, for example? Did it vary depending on social class? Was it different in industrialised and non-industrialised countries?

9. LONG SLEEPERS

9.1. INTRODUCTION

Most of the focus of health risk has been short sleep (ie: not enough), most often seen in the form of insomnia. It is estimated that 10-15% of Americans suffer from chronic insomnia (Shepard 2005).

But long sleeping can be a problem. Hartmann et al (1972), in a comparison of short and long sleepers by choice, found the latter had less energy and more psychological problems than the former.

9.2. SLEEP PROBLEMS

Grandner et al (2004) analysed data from the "Sleep in America" survey (National Sleep Foundation 2001) of over one thousand US adults. Both short (4-6 hours) and long (9-10 hours) sleepers reported more sleep problems than the average (table 9.1).

SLEEP PROBLEM	LONG SLEEPERS (9-10 hrs)	AVERAGE SLEEPERS (7-8 hrs)	LEVEL OF SIGNIFICANCE
• Difficulty falling asleep	33.7	12.0	<0.0005
• Waking during night	44.2	21.4	<0.0005
• Waking too early	25.3	15.5	<0.05
• Waking unrefreshed	35.8	21.0	<0.005
	24.2	13.0	<0.05

Table 9.1 - Percentage of long and average sleepers reported sleep problems.

The "Sleep in America" survey has a number of strengths and weaknesses (table 9.2).

9.3. HEALTH

In 1959-60 the American Cancer Society questioned more than one million Americans about their health, and then followed them up six years later (Cancer Prevention

STRENGTHS	WEAKNESSES
1. Sample matched to US census, except more college educated. 2. Large sample (N = 1004). 3. Structured interviews used (ie: same questions for all). 4. Quantitative data collected with a Likert scale; eg: "You woke up feeling unrefreshed?" - never (1); rarely (2); few nights a month (3); few nights a week (4); every night or almost every night (5). 5. Straightforward statements used; eg: "You were awake a lot during the night?". 6. Gives general pattern of the population.	1. Weaknesses of telephone interviews (appendix 4). 2. Depends on honesty and accuracy of recall of information provided with no independent verification. 3. Survey included limited number of questions about sleep problems (ie: 5). 4. Only small number of respondents were long sleepers compared to average and short sleepers (ie: comparison groups not equal size). 5. For analysis the ordinal data of the Likert scale reduced to nominal data of sleep problems (4-5) or not (1-3). The decision point is subjective. 6. Not psychometric questionnaire with established reliability and validity.

Table 9.2 - Strengths and weaknesses of "Sleep in America" survey.

Study I; CPSI). Sleeping more than eight hours per day was found to be a risk for mortality more than sleeping less than the average (7 hours per day)(Garfinkel and Stellman 1985).

The CPSII began in 1982 with a questionnaire and then a follow-up in 1988. Kripke et al (2002) analysed the data in terms of sleep length and mortality. The average sleep duration was 7-8 hours. Both men and women who slept for nine hours or more on average had a greater mortality risk (table 9.3).

	MALE	FEMALE
LONG SLEEPERS - 9 hours - 10 hours+	 1.17 * 1.34	 1.23 1.41
SHORT SLEEPERS - 4 hours	 1.17	 1.11

(* 1.0 = baseline for average sleepers)

(After Kripke et al 2002)

Table 9.3 - Mortality risk for extreme sleepers.

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9.5. APPENDIX 4 - TELEPHONE INTERVIEWS

Telephone interviews compared to face-to-face interviews and self-administered postal questionnaires have strengths and weaknesses (table 9.4).

For example, McCormick et al (1993) compared the data from their research on parents of children with very low birth weight using seven scales in an hour-long interview asked via the telephone or face-to-face. It was proposed that telephone interviews would produce lower quality information as shown by fewer responses and more incomplete ones. However, this was not found. There was no difference based on mode of interview. Both modes had equal amounts of fatigue by the end of the interview.

But the groups were not assigned randomly. Face-to-face interviews were conducted with participants without telephones, and telephone interviews with those who could not physically come to the clinic.

STRENGTHS	WEAKNESSES
1. More cost efficient than face-to-face interviews. 2. Higher response rates and more complete responses than mailed questionnaire, except for very sensitive questions (McCormick et al 1993). 3. Best way to obtain non-self-reported information from individuals distant from the	1. Cannot use visual cues to remind respondents of response categories. Thus concern that full range of responses will not be used (ie: response bias). 2. Response rates less than face-to-face interviews in many cases (McCormick et al 1993). 3. Less use with very long interviews.

Table 9.4 - Strengths and weaknesses of telephone interviews.

9.6. APPENDIX 5 - WEB SEARCH ACTIVITY

Search for famous long sleepers in history and alive today. How long do/did they sleep on average? Does/Did it affect their health?

Here are two examples to start:

- Abraham de Moivre - 20 hours per day in old age; French mathemician (1667 - 1754) (http://dreamtalk.hypermart.net/teachers/fameslp.htm; accessed 15/7/09)

- Actress Penelope Cruz - 12 hours per day (Williams and Boden 2004)

10. EPWORTH SLEEPINESS SCALE

10.1. EPWORTH SLEEPINESS SCALE

The Epworth sleepiness scale (ESS)(Johns 1991) measures the severity of daytime sleepiness with eight questions on a scale from 0-24 (Box 10.1). A higher score means greater daytime sleepiness, and over ten is called as "pathological sleepiness". Daytime sleepiness is important because it is associated with many sleep disorders like insomnia or sleep apnea, as well as being the cause of accidents.

"How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?"

0 = Never
1 = Slight chance
2 = Moderate chance
3 = High chance

1. Sitting and reading.
2. Watching TV.
3. Sitting, inactive in a public place (eg: theatre or meeting).
4. As a passenger in a car for an hour without a break.
5. Lying down to rest in the afternoon when circumstances permit.
6. Sitting and talking to someone.
7. Sitting quietly after a lunch without alcohol.
8. In a car, while stopped for a few minutes in the traffic.

(Source: Shen et al 2006)

Box 10.1 - Epworth sleepiness scale.

10.2. MEXICAN VERSION OF ESS

Though the ESS can be used universally, it has also been translated into a number of languages, like German (Bloch et al 1999) and Italian (Vignatelli et al 2003).

Versions of the ESS in other languages are not just direct translations, but they are adapted to fit the culture. For example, Jiménez-Correa et al (2009) removed item 8 in the Mexican version because the majority of people use public transport.

Though there is a Spanish version of the ESS (Izquierdo-Vicario et al 1997), such cultural differences meant that a Spanish-language version for the Mexican population was needed.

Jiménez-Correo et al (2009) asked sleep medicine professionals to translate the ESS, and this version was tested on students at the Metropolitan University in Iztapalapa, Mexico, and patients and accompanying adults (healthy controls) at the Sleep Disorders Clinic at the National Autonomous University of Mexico (UNAM), Mexico City.

The validity of the new version (without item 8) can be established by comparing the scores of different groups. There should be significant differences in ESS scores between healthy and sleep disordered individuals. This was the case (table 10.1).

HEALTHY STUDENTS (N = 694)	HEALTHY ADULTS (N = 66)	PATIENTS WITH SLEEP DISORDERS (N = 313)
7.81	6.40	10.49

(After Jiménez-Correa et al 2009)

Table 10.1 - Mean score (out of 21) on the Mexican version of the ESS (Escala De Somnolencia Epworth).

Convergence validity was established by correlating the time to fall asleep during the Mean Sleep latency Test (MSLT) and the Mexican version of the ESS for thirty of the sleep disordered individuals. They fell asleep quicker during the day in MSLT with a higher ESS score (negative correlation; r = -0.537). Furthermore, severity of sleep apnea positively correlated with ESS score.

The Mexican version of the ESS, however appropriate to its culture, shares a number of limitations of the ESS generally.

1. It is dependent upon the accuracy and honesty of respondents' answers.

2. The choice of scenarios are limited, which may reduce the sensitivity of the ESS (Violani et al 2003).

3. Illiterate individuals will need help (Maldonado et al 2004).

4. The ESS does not measure daytime sleepiness at the time of answering, but at the time when the scenarios presented were last experienced (Jiménez-Correo et al 2009).

5. Some individuals may not have experienced the scenarios, or experienced them recently. So their answers may be guesses or imaginings. Furthermore, the scoring is

distorted when individuals do not regularly experience any of the scenarios.

6. The response categories may be interpreted differently by individuals; eg: "moderate chance" or "high chance".

7. Individuals may not be able to understand the distinction between "dozing off" and tiredness.

10.3. REFERENCES

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