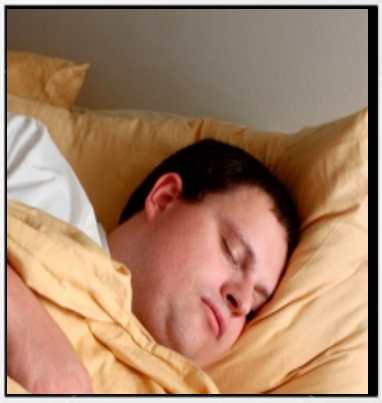
DEMENT & KLEITMAN (1957) then and now

e-xtension

Dr. Julia Russell's Psychology Column

Dement & Kleitman (1957) is a classic study which explored sleep and dreaming using electronic recording as well as observation and diary methods. It is summarised in the box opposite. Dement & Kleitman's research aimed to find objective ways to investigate the previously entirely subjective study of dream content by looking for relationships between eye movements in sleep and the dreamer's recall.



Our eyes move around under the lids while we dream.

Why is studying sleep so hard?

Sleep and dreaming is a difficult topic to study simply because the participant is asleep so they cannot readily respond or communicate. Furthermore, as dream reports can only be obtained by self-report, they are necessarily subjective. One way to improve the scientific rigour of the study of dreaming is to use physiological measures of the dream state. This possibility was achieved by Aserinsky & Kleitman (1955) just two years before Dement & Kleitman's study.

Research questions:

- **Can objective methods demonstrate a relationship between dream content and physiological indicators of dreaming?**
- **Does dream recall differ between REM and nREM stages of sleep? (a)**
- **Is there a positive correlation between subjective estimates of dream duration and the length of the REM period before waking? (b)**
- **Are eye movement patterns related to dream content? (c)**

Procedure:

- 7 male and 2 female participants, 5 of these studied in detail.
- In the day, the participant ate normally (excluding coffee and alcohol) then arrived at the laboratory just before their normal bedtime.
- The participant went to sleep with electrodes attached beside the eyes (EOG) and on the scalp (EEG), which fed to the experimenter's room. Participants were woken (by a doorbell) at various times during the night, asked to describe their dream if they were having one, then returned to sleep.
- (a) participants were woken either in REM or nREM (but not told which). They confirmed whether they were having a dream and described the content into a recorder.
- (b) participants were awoken after either 5 or 15 minutes in REM sleep. They chose which duration they had been woken up after. Longer REM periods were also allowed. The number of words in the dream narrative was counted (although this was affected by how expressive the participant was).
- (c) The direction of eye movements was detected using electrodes around the eyes. Participants were woken after the persistence of a single eye-movement pattern for more than one minute and asked to report their dream. The eye-movement patterns were: mainly vertical, mainly horizontal, both vertical and horizontal, very little or no movement.

Findings:

- Uninterrupted dream stages lasted 3-50 minutes (mean approx 20 minutes), were typically longer later in the night and showed intermittent bursts of around 2-100 REMs.
- the cycle length varied between participants but was consistent within individuals, eg 70 for one, 104 for another.
- When woken in nREM participants returned to nREM, but when woken in REM they typically didn't dream again until the *next* REM phase (except sometimes in the final REM phase).
- (a) Participants frequently described dreams when woken in REM but rarely did from nREM sleep (although there were some individual differences) and this differences was marked at the end of the nREM period (within 8 minutes of cessation of REM – only 6 dreams recalled in 132 awakenings). In nREM awakenings, participants tended to describe feelings but not specific dream content.
- (b) Accuracy of estimation of 5 or 15 minutes' of REM was very high (88% and 78% respectively). REM duration and number of words in the narrative were significantly positively correlated.
- (c) Eye movement patterns were related to dream content, eg horizontal movements in a dream about throwing tomatoes, vertical ones in a dream about ladders and few movements in dreams about staring fixedly at something.

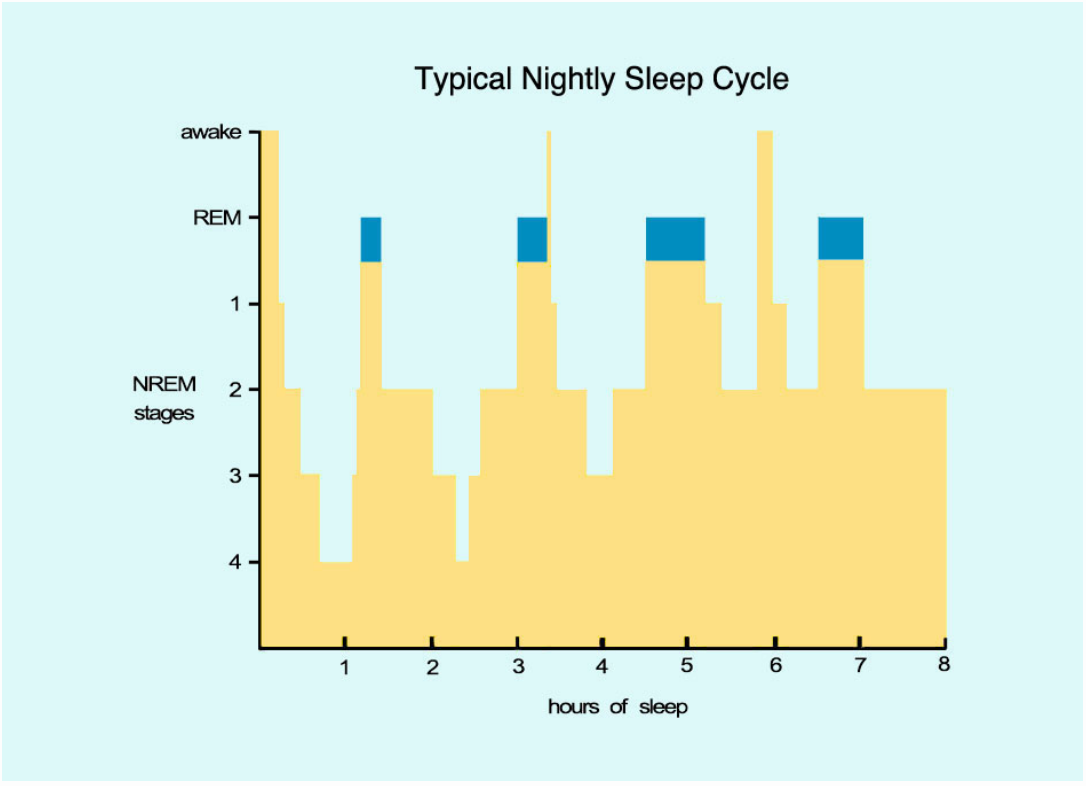
Conclusion:

Dreaming is reported from REM but not nREM sleep, participants can judge the length of their dream duration and REM patterns relate to dream content.

Physiological methods in sleep research

EEG – break the word down to its parts:
E*lectro (electric)*
En *cephalo (in head)*
G*raph (writing).*
This will help you to understand and remember the name.

Although physiological measures of sleep had been available for some years, Aserinsky & Kleitman (1955) were the first to use these to explore the relationship between sleep and dreaming. Two key ideas are important, both using an **electroencephalograph (EEG)**. The EEG is a machine which can detect and record minute changes in voltage associated with electrical activity in nerve and muscle cells when many are active at the same time. This is recorded using **macroelectrodes** (large, flat electrodes stuck to the skin or scalp). Note that they are *recording* electrodes – they cannot used to give the participant an electric shock. An EEG is used to record the simultaneous activity of groups of neurons in the brain. It produces a chart (an encephalogram) which shows how 'brain waves' vary, ie how the **frequency** and **amplitude** (height) of electrical output from the brain changes over time. The chart provides a record of changes which indicate the sleep stage a person is in (see Figure 2). This shows that we go through several cycles of stages during each night, one of which is dream or **rapid eye movement sleep** (REM). This is so called because our eyes move rapidly under the lids while we are dreaming but not at other times during sleep. During this stage of sleep; Aserinsky & Kleitman found that when participants were woken they were more likely to report a vivid, visual dream than in other stages (called, collectively, NREM or **non-rapid eye movement sleep**).



In addition, an EEG can be used to record the frequency of eye movements by attaching electrodes to the skin beside each eye.
This is called an **Electo-occulograph (EOG)**.

How different is brain activity in REM and in waking?

REM or dream sleep is also called **paradoxical sleep**. This is because it is both very different from waking but very similar too. In both stages of the sleep-wake cycle, our brains generate **beta waves**, quite high frequency, low amplitude waves detected by an EEG which suggest the brain is active.

Kahan & Laberge (2010) observe that dreaming is typically believed to lack high-order cognitive skills but suggest instead that "the dreaming mind is highly similar to the waking mind" (their alternative hypothesis). Experience samples (qualitative dream/thought reports) were obtained from late-night REM sleep and waking, following a systematic protocol. They found that dreaming and waking experiences were surprisingly similar in both cognitive and sensory qualities but differed markedly in terms of general reality orientation and logical organisation (eg how bizarre or typical the events, actions and locations were).

How different are REM and nREM?

Evidence since Dement & Kleitman suggests there are more similarities between REM and nREM than were initially recognised. For example, we do appear to have a kind of 'dream' in nREM, but it is experienced as 'thinking' rather than the vivid, visual dreaming associated with REM sleep. However,
McNamara *et al.* (2010) have also found an apparent difference between the two sleep stages. Traditionally (ie from Dement & Kleitman) we see REM reports as bizarre (unfamiliar), improbable and often unpleasant and nREM as more familiar (thought-like rather than bizarre) and with improbable and unpleasant events being less frequent. These differences are by degrees. One stark difference, however, is in social interactions.

Traditionally, sleep stages were indexed using EEG but more recently this has been done using brain scanning. However, this technique can't detect nREM stages, so EEGs were used by McNamara *et al.* too. In other respects the laboratory phase of their study used procedures much like Dement & Kleitman, with participants refraining from alcohol, continuing normal daytime activities and being woken up in different stages to record their dreams to audiotape.

McNamara *et al.* used qualitative data from their own and other recent studies to content-analyse hundreds of reports (including REM, nREM and waking mentation). One difference between this study and Dement & Kleitman, was how these were analysed – this study used a computerized word count: an unbiased procedure which avoids the risk of subjectivity influencing the categorization of dream reports. The analysis showed that in REM, dreamer-initiated aggression is more frequent whereas in nREM social interactions more often include dreamer-initiated friendliness. Interestingly, although more aggressive, and rated as more intense, the emotions reported by the dreamers were not significantly more negative in REM – aggression, it seems, is not unpleasant unless you are on the receiving end!

Key terms

amplitude – the 'height' of waves eg on an EEG (indicating voltage).
beta waves - relatively high frequency, low amplitude waves detected by an EEG which indicate active thinking. They are seen in both wakefulness and REM sleep.
diary method – a research method using regular self reports.
electro-occulograph (EOG) - the use of an EEG to detect and record the frequency of eye movements by attaching electrodes to the skin beside each eye.
electroencephalograph (EEG) – a machine which uses macroelectrodes on the surface of the skin or scalp to detect simultaneous firing of groups of neurons. It can detect different stages of the sleep-wake cycle, representing them as lines on a graph-like 'trace'
frequency – the number of events per fixed period of time, eg the number of eye-movements per minute (approximately 60/minute in REM sleep) or the number of brain waves (cycles) per second or 'Hertz (Hz) eg 13-30 Hz for beta waves.
macroelectrodes - large, flat electrodes stuck to the skin or scalp used to record electrical activity.
non-rapid eye movement sleep (nREM) – stages 1,2,3 and 4 of sleep ie those stages which are not REM sleep.
paradoxical sleep - REM or dream sleep.
rapid eye movement sleep (REM) – a stage of sleep characterised by bouts of rapid movements of the eyes and by vivid, visual dreams.

Activity

Christman & Propper (2010) divided their participants into handedness groups in terms of degree: *strong/consistent* versus *mixed/inconsistent* (rather left/right). They found that consistent right-handers spent more time in REM and less in nREM compared to other groups.

You could attempt to replicate this study using a sleep app which can be cheaply downloaded. Apps such as *Sleep Cycle* illustrated in Figure 3 can be used to measure the time the individual spends in REM and nREM. You could then ask them about what hand they use for different tasks (eg writing, teeth cleaning, using just a fork or spoon, using a mouse, waving, pointing etc - make up your own list).

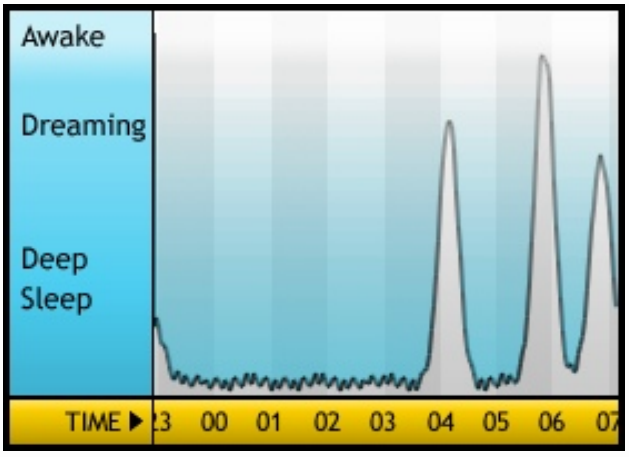
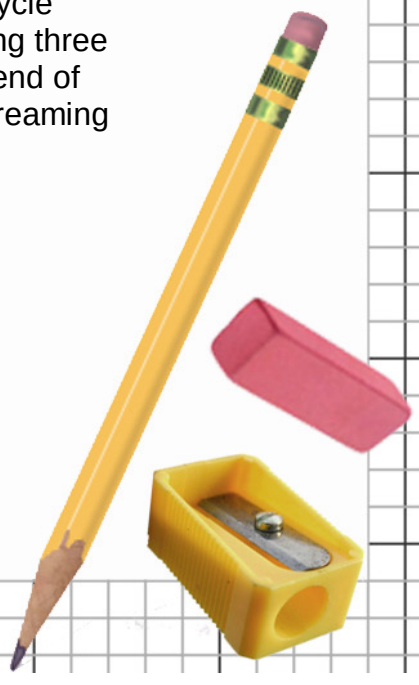


Figure 3 A Sleep Cycle app output illustrating three cycles towards the end of the night in which dreaming occurred



Questions

1. In this study, what is the independent variable and what are the levels of the independent variable?

2. a) What is the dependent variable?

   b) How will you measure the dependent variable?

3. a) Describe why this study could raise ethical issues.

   b) Suggest **two** ways to minimize the ethical issues you have identified.

Stretch & Challenge

Find out how apps such as *Sleep Cycle* work. Can you explain how the technique they are using to differentiate REM and nREM sleep works?

Information is available at: http://mdlabs.se/sleepcycle/

References

Aserinsky E & Kleitman N (1955) Two types of ocular motility occurring in sleep. *Journal Applied Physiology*, 8: 1-10.

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Dement W & Kleitman N (1957) The relation of eye movements during sleep to dream activity: an objective method for the study of dreaming. *Journal of Experimental Psychology*, 53: 339-46.

Kahan TL & Laberge SP (2010). Dreaming and waking: Similarities and differences revisited. *Consciouness & Cognition*, doi: 10.1016/j.concog.2010.09.002 [epub ahead of print].

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Answers

1. In this study, what is the independent variable and what are the levels of the independent variable? IV= consistency of handedness; levels = *strong/consistent, mixed/inconsistent*
2. a) What is the dependent variable? Amount of time spent in REM / nREM sleep per night.
   b) How will you measure the dependent variable? Average time spent in REM / nREM over X nights.
3. a) Describe why this study could raise ethical issues. eg Participants may find that the knowledge that their sleep is being monitored disruptive, reducing sleep time or quality.
   b) Suggest **two** ways to minimise the ethical issues you have identified. Use only participants already familiar with the sleep app, allow them time to familiarise themselves with the system prior to recording data.