9.8 Explanations of sleep disorders

NARCOLEPSY

Narcolepsy is a serious, but relatively uncommon, sleep disorder causing sudden sleep, lack of muscle control and dream experiences at inappropriate times during the day.
The main symptoms are:

- Excessive daytime sleepiness – feeling tired with an overwhelming need to sleep during the day, despite a good night's sleep and situations demanding full alertness.
- Sudden and uncontrollable attacks of sleep (that can even occur during conversations or while driving) that can last from 30 seconds to 30 minutes or more.

Auxiliary symptoms can include:

- Hypnagogic hallucinations – visual dreamlike hallucinations experienced at sleep onset or on waking.
- Temporary paralysis – partial or total paralysis while awake causing an inability to move or speak.
- Cataplexy – sudden partial or total decreased muscle tone, usually triggered by an emotional event, that can cause collapse to the ground in a conscious state, risking injury.

Narcolepsy is thought to affect 1 in 10,000 people and starts in adolescence. The symptoms can be dangerous and frightening for the sufferers (and other people), and may harm their personal and professional relationships.

Explanation

Narcolepsy seems to have a biological cause relating to malfunction in the brain areas responsible for controlling sleep and wakefulness, in particular REM sleep onset. Patients with narcolepsy frequently go directly into REM periods when they sleep, without the usual initial NREM period of deep sleep, meaning they may be less rested. Worse still, the auxiliary symptoms occur when REM sleep (with its paralysis and dreaming) intrudes into wakefulness.

Evaluation

The exact cause of the REM sleep advance is not yet known, although deficiencies in the brain proteins orexin and hypocretin (which play a role in sleep patterns) and variations in chromosome 6 may be involved.

SLEEPWALKING

Sleepwalking (somnambulism) refers to recurring episodes of complex behavioural movements, each lasting from around 15 seconds to 30 minutes, usually involving:

- Sitting up, getting out of bed and moving around while in a state of sleep. Eyes are open but unfocused allowing navigation around or outside the home and fairly complex interactions (even driving) with the environment.
- No (or partial and vague) recall of the event.

Sleepwalking may be preceded by night terrors, in which case there can be less responsiveness to external stimuli and fleeing/defence movements may be more energetic/ violent. Sleepwalking is more common in children than in adults. It is most likely to occur during the first third of the night during the first NREM period.

Explanations

Oliviero *et al.* (2008) suggest a lack of the neurotransmitter GABA (which inhibits the motor system during sleep) may be involved, since the GABA system develops slowly in childhood. Twin concordance studies show a genetic influence and sleepwalking is aggravated by stress and certain medications. In the elderly sleepwalking is more often due to waking disorientation caused by dementia.

Evaluation

EEG monitoring confirms that sleep is maintained throughout sleepwalking, which occurs during the deep, delta slow-wave, stages 3 and 4 of NREM sleep.

SLEEP TERRORS

Sleep terrors (pavor nocturnes) are sleep disturbances when:

- Moaning and/or thrashing may occur, followed by screams, a terrified appearance and agitation lasting several minutes – all often without full wakefulness.
- Signs of sympathetic nervous system over-activity occur, including accelerated heart and breathing rate, pupil dilation, sweating, and increased blood pressure.
- There is complete amnesia or only partial recall (e.g. vague memories of threat or danger) of the event.

Like sleepwalking, sleep terrors occur early in the night and are most common in children (up to 5% may suffer, though this decreases during adolescence).

Explanations

Sleep terrors in childhood can be triggered by emotional stress, over-tiredness or disruption to normal sleep rhythms affecting an underdeveloped sleep system. In adults, post traumatic stress disorder may be implicated.

Evaluation

EEG monitoring confirms that sleep terrors usually occur during stages 3 and 4 of NREM sleep.
Sleep terrors can be distinguished from nightmares by the occurrence of amnesia for the event.
Sleep terrors may overlap with sleepwalking, implying a possible link in the brain processes involved, but further research is needed.

REM SLEEP BEHAVIOUR DISORDER

REM sleep behaviour disorder occurs when:

- Sleep is disrupted by complex, active or violent behaviour which can cause damage to the dreamer or those sharing the bed.
- Sleeping behaviour is associated with or reflects vivid dream thoughts and images which are recalled on waking.

It occurs most often in the middle-aged or elderly.

Explanations

The disorder represents pathology of REM sleep whereby the normal muscle paralysis of this type of sleep does not occur or is not maintained, often due to neurological diseases that are more common in older adults.
The disease may affect structures of the brainstem, e.g. the pons, responsible for suppressing muscle movement during REM sleep.

Evaluation

Laboratory observation and EEG recording may be necessary to distinguish the disorder from night terrors, panic attacks or seizures, although the recollection of dream content and the higher frequency in adults helps diagnosis.

10.1 Types of memory

ENCODING TYPES OF MEMORY

The human sensory systems, such as our eyes and ears, receive many different forms of stimulation, ranging from sound waves to photons of light. Obviously the information reaching our senses is transformed in nature when it is represented in our brains, and encoding refers to the process of representing knowledge in different forms.

Imagery memory

- Some memory representations appear to closely resemble the raw, unabstracted data containing original material from our senses, such as the extremely brief iconic (visual) and echoic (auditory) after images that rapidly fade from our eyes and ears. Yet even after these have gone, we retain the ability to recall fairly vivid visual images of what we have seen and to hear again tunes we have experienced.
- Baddeley and Hitch (1974) have investigated this sort of short term imagery ability by suggesting that we have a 'visuospatial scratchpad' for summoning up and examining our visual imagery.
- Photographic (eidetic) memory is an extremely rare ultra enhanced form of imagery memory, shown in a weak form by perhaps 5% of young children (Haber, 1979).

Procedural memory

- Also known as implicit memory, this is the memory for ***knowing how*** to do things such as talk, walk, juggle, etc. Although we retain these skills and abilities, we are often completely ***unable to consciously introspect upon or describe*** how we do them. Procedural memory is similar to Bruner's enactive mode.
- Procedural knowledge is very resistant to forgetting (we never forget how to ride a bicycle) and is also resistant to brain damage that eradicates other forms of memory – anterograde amnesiac patients, who forget simple events or verbal instructions after a few moments, are often able to learn new procedural skills such as playing table-tennis.

Declarative memory

- Sometimes termed explicit memory, this type concerns all the information that we can ***describe or report***, and as such has been the focus of the *majority* of research on memory. Declarative memory includes:
  - **a** **semantic memory** – this concerns memory for meaning, the storage of abstract, general facts regardless of when those facts were acquired e.g. *knowing what* a word means.
  - **b** **episodic** – this is 'knowing when' memory based upon personal experience and linked to a particular time and place in our lives. Episodic memory can be quite precise – Lindsay and Norman (1977) asked students "what were you doing on a Monday afternoon in the 3rd week of September, 2 years ago?", and found many actually knew. Very vivid episodic memories have been termed 'flashbulb' memories (Brown and Kulik, 1977) which involve recalling exactly what you were doing and where you were when a particularly important, exciting or emotional event happened.

DURATION TYPES OF MEMORY

Ever since William James (1890) distinguished between *primary* memory which feels like our present conscious experience, and *secondary* memory which seems like we are 'fishing out' information from the past, cognitive psychologists have been very interested in the possibility of different types of memory store based on the duration of time memories last for. Cognitive psychologists have proposed ***three types*** of time based store, each with differences in duration, capacity, coding and function.

Sensory memory

(Sometimes called the short term sensory store or sensory register.)

- The sense organs have a limited ability to store information about the world in a fairly unprocessed way for less than a second, rather like an afterimage. The visual system possesses ***iconic*** memory for visual stimuli such as shape, size, colour and location (but not meaning), whereas the hearing system has ***echoic*** memory for auditory stimuli.
- Coltheart *et al.* (1974) have argued that the momentary freezing of visual input allows us to select which aspects of the input should go on for further memory processing. The existence of sensory memory has been experimentally demonstrated by Sperling (1960) using a tachistoscope.

Short-term memory

- Information selected by attention from sensory memory, may pass into short-term memory (STM).
- STM allows us to retain information long enough to ***use*** it, e.g. looking up a telephone number and remembering it long enough to dial it. Peterson and Peterson (1959) have demonstrated that STM lasts approximately ***between 15 and 30 seconds,*** unless people rehearse the material, while Miller (1956) has found that STM has a ***limited capacity*** of around ***7 'chunks'*** of information.
- STM also appears to mostly ***encode*** memory ***acoustically*** (in terms of sound) as Conrad (1964) has demonstrated, but can also retain visuospatial images.

Long-term memory

- Long-term memory provides the lasting retention of information and skills, from ***minutes*** to a ***lifetime.***
- Long-term memory appears to have an almost ***limitless capacity*** to retain information, but of course its capacity could never be measured – it would take too long!
- Long-term information seems to be encoded mainly in terms of ***meaning*** (semantic memory), as Baddeley has shown, but also retains procedural skills and imagery.

10.2 Research on sensory memory, short-term and long-term memory

SENSORY MEMORY

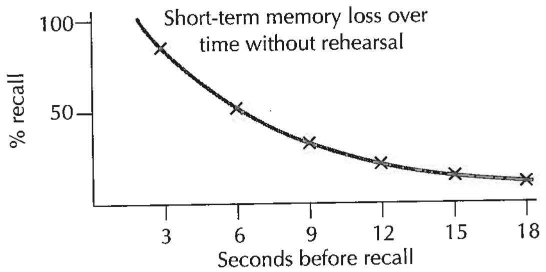
- Since sensory memory lasts less than a second, most of the material in it will have been forgotten before it can be reported! ***Sperling*** studied the sensory memory for vision (the iconic store) by using a ***tachistoscope*** – a device that can flash pictoral stimuli onto a blank screen for very brief instances. Using this device, Sperling was able to ask subjects to remember as many letters as they could from a ***grid of 12 symbols*** that he was going to display for just ***one twentieth of a second***, and found that while they could only recall around ***four*** of the symbols before the grid faded from their sensory memory, they typically reported seeing a lot more than they had time to report.
- **Capacity** – Sperling presented the 12 symbol grid for 1/20th of a second, followed immediately by a ***high, medium*** or ***low tone,*** which indicated which of the three rows of four symbols the subject had to attend to from their iconic memory of the grid. In this partial report condition, recall was on average just over 3 out of the 4 symbols from any row they attended to, suggesting that the iconic store can retain ***approximately 76%*** of all the data received.

Step 1 Show grid	Step 2 Ring tone	Step 3 Recall letters
7 1 V F		? ? ? ?
X L 5 3	Medium tone	X L 5 3
B 4 W 7		? ? ? ?

- **Duration** – If there was a delay between the presentation of the grid and the sounding of the tone, Sperling found that more and more information was lost (only 50% was available after a 0.3 second delay and only 33% was available after a 1 second delay).

SHORT-TERM MEMORY

- **Duration** – Peterson and Peterson (1959) investigated the duration of short-term memory with their ***trigram experiment***. They achieved this by
  1. asking subjects to remember a single nonsense syllable of three consonants (a *trigram* of letters such as FJT or KPD).
  2. giving them an *interpolated task* to stop them rehearsing the trigram (such as counting backwards in threes from one hundred).
  3. testing their *recall after* 3, 6, 9, 12, 15 or 18 seconds (recall had to be perfect and in the correct order to count). While average recall was very good (about 80%) after 3 seconds, this average dropped dramatically to around 10% after 18 seconds.



- **Capacity** – Many early researchers in the area of memory, including Ebbinghaus, noted that short term memory appears to have a limited storage capacity. *Miller* (1956) investigated this limited capacity experimentally, refering to it as ***'The magical number seven, plus or minus two'***. Miller found that the amount of information retained could be increased by ***chunking*** the information – packaging it into larger items or units, although the STM can still only retain 7 + or – 2 of these chunks. Chunking is greatly improved if the chunks already have ***meaning*** from LTM.

Unchunked items
0 1 0 3 3 8 9 8 2 1 8 6 5 7
M P I B M I T V A A F B I R A F
Chunked items
0 1 0   3 3   8 9 8   2 1   8 6 5 7
M P   I B M   I T V   A A   F B I   R A F

- **Encoding** – It has been argued that the main way information is encoded or retained in STM is through sound – an ***acoustic code***. Regardless of whether we see or hear material, we tend to find ourselves repeating the information verbally to ourselves to keep it in mind (STM), and hopefully pass it on to long term storage. Conrad (1964) demonstrated acoustic STM encoding, finding that rhyming letters were significantly harder to recall properly than non rhyming letters, mostly due to acoustic confusion errors, e.g. recalling 'B' instead of 'P'. Baddeley found similar effects for rhyming vs. non-rhyming words. Den Heyer and Barrett (1971) showed that STM stores visual information too.

1) **B T C P G E D**
2) **F T Z Q W R N**
3) **MAT, CAT, SAT, BAT, HAT, RAT, FAT**
4) **PIE, SIX, TRY, BIG, GUN, HEN, MAN**

Acoustic confusion errors are made when recalling lists 1 & 3, even though the letters are visually presented. This shows the material is retained acoustically in STM.

LONG-TERM MEMORY

- **Duration** – Ebbinghaus tested his memory using nonsense syllables after delays ranging from 20 minutes to 31 days later and found that a large proportion of information in LTM was lost comparatively quickly (within the first hour) and thereafter stabilised to a much slower rate of loss.
  Linton used a diary to record at least 2 'every day' events from her life each day over 6 years, and randomly tested her later recall of them. She found a much more even and gradual loss of data over time (approx. 6 % per year).
- **Capacity** – Enormous but impossible to measure.
- **Encoding** – Baddeley (1966) showed that LTM stores information in terms of meaning (semantic memory), by giving subjects four lists to remember.
  If recall was given immediately, list A was recalled worse than list B, but there was little difference between the recall of lists C and D, indicating acoustic STM encoding.
  After 20 minutes, however, it was list C that was recalled worse than D since words with similar meanings were confused, indicating semantic LTM encoding.

Baddeley's (1966) lists:

List A – Similar sounding words e.g. man, map, can, cap.

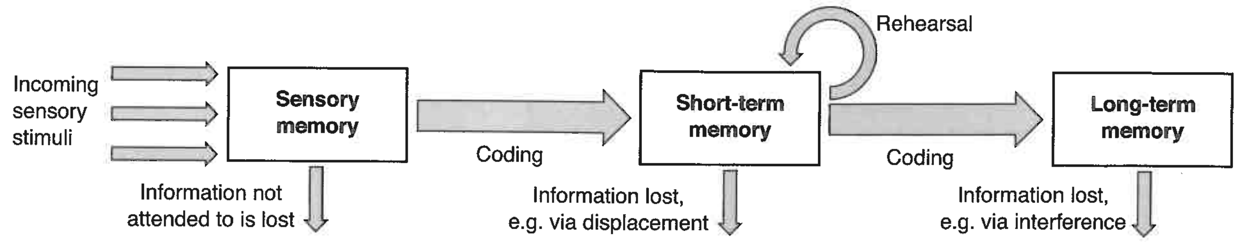
List B – Non similar sounding words e.g. try, pig, hut, pen.

List C – Similar meaning words e.g. great, big, huge, wide.

List D – Non similar meaning words e.g. run, easy, bright.

10.3 Multi-store model of memory

- Much research was devoted to identifying the properties of sensory, short-term, and long-term memory, and cognitive psychologists such as Atkinson and Shiffrin (1968) began to regard them as **stores** – hypothetical holding structures.
- Atkinson and Shiffrin proposed the two-process model of memory, which showed how information flowed through the two stores of short-term and long-term memory, but like many of the models, they assumed the existence of a sensory memory that precedes the short-term memory, and so it is sometimes termed the multi-store model.

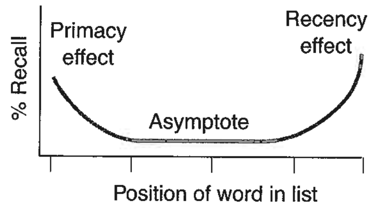


- Atkinson and Shiffrin regarded the stores as the **structural components** of the model, but also proposed a number of **control processes,** such as attention, coding and rehearsal, which operate in conjunction with the stores.

In addition to the research on the differing durations, capacities, etc. of the memory stores there are two main lines of evidence that support the model's assumptions about the way information flows through the system and the distinct existence of short-term and long-term memory stores – free recall experiments and studies of brain damaged patients.

FREE RECALL EXPERIMENTS

- In free recall experiments, subjects are given a number of words (for example 20) in succession to remember and are then asked to recall them in any order ('free recall'). The results reliably fall into a pattern known as the **serial position curve**. This curve consists of



  a. a **primacy effect** – Subjects tend to recall the first words of the list well, which indicates that the first words entered short-term memory and had time to be rehearsed and passed on to long-term memory before the STM capacity was reached. The primacy effect, therefore, involves recall from long-term memory.
  b. an **asymptote** – The middle portion items of the list are remembered far less well than those at the beginning and the end. This is probably because the increasing number of items fills the limited capacity of the STM and these later items are unable to be properly rehearsed and transferred to LTM before they are displaced.
  c. a **recency effect** – Subjects usually recall those items from the end of the list first, and tend to get more of these correct on average than all the earlier items. This effect persists even if the list is lengthened (Murdock, 1962), and is thought to be due to recall from the short-term memory store – since the items at the end of the list were the last to enter STM and were not displaced by further items.
- Further evidence for the primacy/recency effects comes from two other findings:
  a. Slower rates of presentation can improve the primacy effect perhaps due to more rehearsal time, but have little or no influence on the recency effect.
  b. The recency effect disappears if the last words are not recalled straight away. Glanzer and Cunitz (1966) gave subjects an interference task immediately after the last word of the list and found a primacy but no recency effect.

STUDIES OF BRAIN DAMAGED PATIENTS

Cases of **anterograde amnesia** such as H.M. (Milner *et al.*, 1978) or Clive Wearing (reported in Blakemore, 1988) provide strong evidence for the distinction between STM and LTM. Anterograde amnesia is often caused by brain damage to the hippocampus and those suffering from it seem incapable of transferring new factual information between STM and LTM. With this inability, they are essentially trapped in a world of experience that only lasts as long as their short-term memory does. Patients afflicted by anterograde amnesia often retain most of their long term memory for events up until the moment of brain damage and maintain their procedural memories. While they seem incapable of gaining new long-term declarative memory for semantic or episodic information most are able to learn new procedural skills (like playing table-tennis).
If these people are given free recall experiments, they show good recency effects but extremely poor primacy effects (Baddeley and Warrington, 1970).

CRITICISMS OF THE MULTI-STORE MODEL

It is too simplistic, in that:

a. It under-emphasises interaction between the stores, for example the way information from LTM influences what is regarded as important and relevant to show attention to in sensory memory and helps the meaningful chunking of information in STM.

b. STM and LTM are more complex and less unitary than the model assumes. This criticism is dealt with by the Working Memory model of STM by Baddeley and Hitch (1974) and by research into the semantic, episodic, imagery and procedural encoding of LTM.

c. Mere rehearsal is too simple a process to account for the transfer of information from STM to LTM – the model ignores factors such as the effort and strategy subjects may use when learning (**elaborative** rehearsal leads to better recall than just maintenance rehearsal) and the model does not account for the type of information taken into memory (some items, e.g. distinctive ones, seem to flow into LTM far more readily than others). These criticisms are dealt with by the Levels of Processing approach of Craik and Lockhart (1972).

10.4 Levels of processing and working memory

LEVELS OF PROCESSING APPROACH TO MEMORY – CRAIK AND LOCKHART (1972)

THE APPROACH

- Craik and Lockhart's important article countered the predominant view of fixed memory **stores**, arguing that it is what the person **does** with information when it is received, i.e. how much attention is paid to it or how deeply it is considered, that determines how long the memory lasts.
- They suggested that information is more readily transferred to LTM if it is *considered, understood* and related to past memories to gain *meaning* than if it is merely *repeated* (maintenance rehearsal). This degree of consideration was termed the '**depth of processing**' – the deeper information was processed, the longer the ***memory trace*** would last.
- Craik and Lockhart gave three examples of **levels** at which verbal information could be processed:
  1. **Structural** level – e.g. merely paying attention to what the words *look* like (very shallow processing).
  2. **Phonetic** level – processing the *sound* of the words.
  3. **Semantic** level – considering the **meaning** of words (deep processing).

EVIDENCE

- Craik and Tulving (1975) tested the effect of depth of processing on memory by giving subjects words with questions that required different levels of processing, e.g.

  'table'

  Structural – 'Is the word in capital letters?'
  Phonetic – 'Does it rhyme with "able"?'
  Semantic – 'Does it fit in the sentence "the man sat at the _____"?'
- Subjects thought that they were just being tested on reaction speed to answer yes or no to each question, but when they were given an unexpected test of recognition words processed at the semantic level were recognised more often than those processed phonetically and structurally.

MODIFICATIONS

Many researchers became interested in exactly what produced **deep** processing:

- **Elaboration** – Craik and Tulving (1975) found complex semantic processing (e.g. 'The great bird swooped down and carried off the struggling __') produced better cued recall than simple semantic processing (e.g. 'She cooked the __').
- **Distinctiveness** – Eysenck and Eysenck (1980) found even words processed phonetically were better recalled if they were distinctive or unusual.
- **Effort** – Tyler *et al.* (1979) found better recall for words presented as difficult anagrams (e.g. 'OCDTRO') than simple anagrams (e.g. 'DOCTRO').
- **Personal relevance** – Rogers *et al.* (1977) found better recall for personal relevance questions (e.g. 'Describes you?') than general semantic ones (e.g. 'Means?').

EVALUATION

- **Strengths** – good contribution to understanding the processes that take place at the time of learning.
- **Weaknesses** – There are many problems with defining 'deep' processing and why it is effective.
- Semantic processing does not always lead to better retrieval (Morris *et al.*, 1977).
- It describes rather than explains.

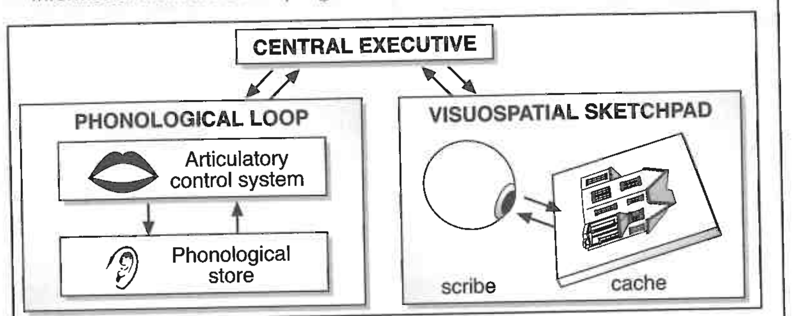
THE WORKING MEMORY MODEL – BADDELEY AND HITCH (1974)

THE MODEL (AS OF 1999)

The working memory model challenged the unitary and passive view of the multi-store model's short-term memory store.

Working memory is an **active** store to hold and manipulate information that is currently being consciously thought about. It consists of 3 separate **components:**

- **The central executive** – a modality-free controlling attentional mechanism with a limited capacity, which monitors and co-ordinates the operation of the other two components or slave systems.
- **The phonological loop** – which itself consists of two subsystems,
  a. The ***articulatory control system*** or 'inner voice' which is a verbal rehearsal system with a time-based capacity. It holds information by articulating sub-vocally material we want to maintain or are preparing to speak.
  b. The ***phonological store*** or 'inner ear' which holds speech in a phonological memory trace that lasts 1.5 to 2 seconds if it does not refresh itself via the articulatory control system. It can also receive information directly from the sensory register (echoic) or from long-term memory.
- **The visuospatial sketchpad** – a visual cache that holds visual and spatial information from the sensory register (iconic) or LTM and an inner scribe.



EVIDENCE

- The existence of separate systems in working memory has been shown experimentally by using concurrent tasks (performing two tasks at the same time) – if one task interferes with the other, then they are probably using the same component.
- Thus, if articulatory suppression (continually repeating a word) uses up the phonological loop, another task involving reading and checking a difficult text would be interfered with, but not a spatial task.

EVALUATION

- Working memory provides a more thorough explanation of storage and processing than the multi-store model's STM.
- It can be applied to reading, mental arithmetic and verbal reasoning.
- It explains many STM deficits shown by brain-damaged patients.
- However, the nature and role of the central executive is still unclear.

10.5 Reconstructive memory

WHAT IS THE RECONSTRUCTIVE APPROACH TO MEMORY?

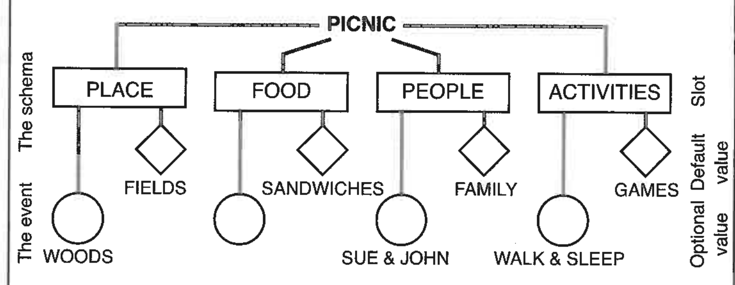
- In contrast to much cognitive research on memory, which focuses on quantitative tests of how many randomly selected digits, words or nonsense syllables can be remembered under strictly controlled conditions, the reconstructive memory approach has tended to concentrate more on ***qualitative changes*** in what is remembered, often of more ***everyday material*** such as stories, pictures or witnessed events under more ***natural conditions***.
- The pioneer of reconstructive memory research was **Bartlett** (1932) who argued that people do not passively record memories as exact copies of new information they receive, but ***actively*** try and ***make sense*** of it ***in terms of what they already know*** – a process he called ***'effort after meaning'***. Bartlett therefore proposed that information may be remembered in a distorted way since memories are essentially 'imaginative reconstructions' of the original information in the light of each individual's past experiences and expectations; rather than remembering what actually happened we may remember what we think should or could have occurred. Bartlett termed the mental structures, that held past experiences and expectations and could influence memory so much, **schemas**.

SCHEMA THEORY

More recent research by cognitive psychologists in the 1970's aimed to specify in more detail the properties of schemas and how they affect memory. Rumelhart and Norman (1983), for example, described how schemas:

1. ***represent*** both simple and complex ***knowledge of all kinds*** (e.g. semantic, procedural, etc.)
2. ***link together*** to form larger systems of related schemas (e.g. a restaurant schema links to other 'eating location' schemas) or smaller systems of sub-schemas (e.g. a restaurant schema consists of sub-schemas of ordering, eating and paying schemas)
3. have slots with ***fixed values*** (defining, unchangeable characteristics), ***optional values*** (characteristics that may vary according to the specific memory the schema is storing) and ***default values*** (the most typical or probable characteristic a schema is likely to encounter)
4. acquire their content through generalised personal ***experience*** or the taught beliefs and stereotypes of a group or society.
5. operate as ***active recognition devices*** – all schemas constantly try to make sense of new information by making the best fit with it.

An example of a picnic schema is given by Cohen (1993) below. Notice that if the food eaten at a particular picnic was forgotten, then it may be assumed that sandwiches were eaten by default. Cohen also points out five ways in which schemas may influence memory – by providing or aiding selection and storage, abstraction, integration and interpretation, normalisation and retrieval. These properties mean that there are both advantages and disadvantages of schemas for memory:



Schema of a picnic (after Cohen *et al.*, 1993)

Advantages – schemas enable us to store the central meaning or gist of new information without necessarily remembering the precise details (abstraction, selection and storage), unless perhaps the details were particularly unusual. This saves memory resources. Schemas also help us understand new information more readily (integration and interpretation, normalisation) and fill in or guess missing aspects of it through the default values (retrieval). This makes the world more coherent and predictable.

Disadvantages – information that does not quite fit our schemas, especially the minor details, may be ignored and forgotten (selection and storage) or distorted (normalisation) so as to make better sense to us, while the guesses/filling-in of memory by the default values (integration and interpretation, retrieval) may be completely inaccurate. This may cause inaccurate, stereotyped and prejudiced remembering.

EVIDENCE FOR SCHEMAS RECONSTRUCTING MEMORY

- Bartlett (1932) found strong evidence for reconstructive memory by asking people to reproduce stories and pictures either serially (by remembering another person's reproduction) or by testing the same person on a number of occasions. When testing English subjects with an unfamiliar North American folk story, 'The War of the Ghosts', Bartlett found their recall became shorter (indicating the gist of the story had been removed) and also distorted by their culture (they omitted unfamiliar details and 'rationalised' the story to make it more coherent and familiar, e.g. recalling the ghosts in 'boats' not 'canoes').
- Brewer and Treyens (1981) tested memory for objects in an office that 30 subjects had waited in individually for 35 seconds. Their 'office schema' seemed to strongly affect their recall. ***Expected*** objects (e.g. a desk) that were in the room were recalled well but ***unexpected*** objects (e.g. a pair of pliers) were usually not. Some subjects ***falsely*** recalled ***expected*** objects that were not actually in the room (e.g. books and pens).
- Bransford and Johnson (1972, 1973) showed how schemas help to encode and store difficult to understand or ambiguous information.

EVALUATION OF RECONSTRUCTIVE MEMORY

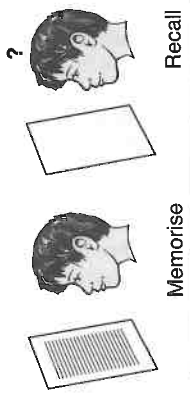
- Bartlett's original research was more ecologically valid than most, but was criticised for its informal nature and lack of experimental controls. However, many recent and well-controlled experiments have consistently shown the reconstructive effect of schemas on memory.
- Bartlett and other reconstructive memory researchers have been accused of over-emphasising the inaccuracy of memory and using unfamiliar material to support the reconstructive effect of schemas on memory. Even quite complex real life material can often be accurately recalled.
- Often unusual information that cannot be easily incorporated into existing schemas (like a skull in the office of the Brewer and Treyens study) is well remembered. This distinctiveness effect has long been noticed and can be accounted for by the schema-plus-tag model of Graesser and Nakamure (1982).
- The concept of a schema and its action is still a little vague.

10.6 Retrieval and forgetting

TYPES OF RETRIEVAL

There are many ways that information may be either retrieved from long-term storage or demonstrate its existence in storage in a less direct manner. Some types are more powerful and accurate than others:

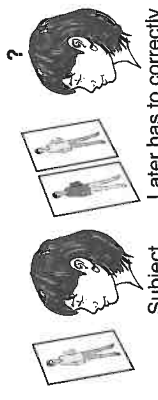
Recall – This involves the active searching of our memory with very few external memory cues, e.g. recalling a list of previously memorised digits or the timed essay situation (we have the question but have to search for the answer).



Re-learning – This involves not necessarily being able to recall or even recognise previously presented material, but being better able to re-learn it on later occasions. Ebbinghaus investigated this type of retrieval and found that there were re-learning savings (it took less time to re-learn material perfectly the more times the list was re-learnt). An everyday example could be re-learning a language that you have not studied for years – you may be unable to recall or even recognise some of the words you had previously learnt, but it would take you less time to re-learn them compared to other, unexperienced words.

Confabulation – This involves the usually unintentional **manufacture** or invention of material to fill in missing details during retrieval. The material added often serves the purpose of making the story more coherent and is likely to occur under conditions of high motivation or emotion.

Recognition – This involves a sense of familiarity with external material whether we can name/identify it or not, for example recognising a face or the correct answer in a multiple choice. In recognition, the material to be retrieved is matched to its external likeness. Recognition is an extremely powerful form of retrieval compared to recall – Standing (1973) showed that subjects in a memory test could correctly identify 10,000 previously presented photographs in recognition tests with very low error rates and little sign of an upper boundary for its capacity.



Reconstruction – This involves retrieval that has **distorted** the original information due to our interpretation of it – based upon our past experiences, beliefs, schemas and stereotypes. Bartlett's subjects not only remembered less of the 'War of the Ghosts' story he presented them, but distorted the story when retelling it by making it more coherent and westernised.

Redintergration – This is where patchy details of an experience will pop into consciousness regardless of what is currently thought about and gradually become more coherent.

PROBLEMS WITH RETRIEVAL (FORGETTING)

When considering theories of forgetting it is useful to distinguish between the concepts of availability and accessibility.
Availability of memory refers to whether the material is actually there to be retrieved – it is not possible to retrieve what has not reached/lasted in long-term storage.
Accessibility of memory refers to the problems involved in retrieving available information – the tip of the tongue phenomena illustrates this type of difficulty.
There is however a **'grey area'** of ambiguity between these two concepts since we can never be 100% sure that what we have forgotten is unavailable – we may not have found the correct memory cue to 'jog our memory', and what cannot be directly recalled or recognised may still exist as a memory trace to aid re-learning.

FORGETTING

AVAILABILITY — **GREY AREA** — **ACCESSIBILITY**

Information not stored
Due to the **limited information processing** ability of human memory, material may not reach long-term storage due to
- limited attentional **capacity** in sensory memory.
- limited capacity and, therefore, **displacement** in short-term memory.

Information stored then permanently lost
Material may reach long-term storage only to be lost there either rapidly due to
- **prevention of consolidation** where memory fixation is disrupted.

Or over a longer time due to
- **trace decay** where memory traces gradually fade.

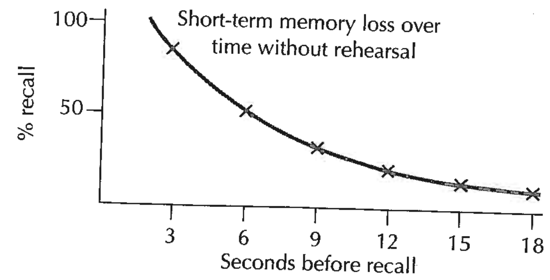
Information 'hidden'
Some experiences may be so traumatic and emotionally disturbing that according to Freud they may be **repressed** – deliberately hidden in the unconscious as a defence mechanism. Such memories are available but need psychoanalysis to access them.

Information awaiting a suitable prompt
Humans frequently experience problems accessing material through unaided recall but may benefit from external cues, as in
- **tip of the tongue phenomena** where a single letter may cue the word that is on the verge of recall
- **state/context dependent recall**

Permanent distortion/replacement	⇐ **Interference** ⇒	Temporary confusion/bias
Permanent destruction of memory	⇐ **Amnesia** ⇒	Temporary concussion

10.7 Forgetting in short-term memory

Short-term memory contains information that is present in our minds and is currently being thought about at any one time, but which soon slips into the past – hopefully to long-term memory so that we can access it again.
Peterson and Peterson (1959) found 90% of STM information was forgotten after just 18 seconds without rehearsal, while memory span studies reveal that forgetting starts once more than 7+/- 2 items enter STM.
We have all been caught out by STM forgetting, e.g. when we forget some of the names of a large group of people we have only just been introduced to, or forget what we were about to say or do next. Cognitive psychologists have provided theoretical explanations of STM's limited duration and capacity.



TRACE DECAY THEORY

- Trace decay theory seems to focus on explaining STM forgetting in terms of its limited duration.
- Donald Hebb (1949) suggested that information in STM created an active trace or engram in the form of a brief excitation of nerve cells that, unless refreshed by rehearsal, would spontaneously fade away or decay over time.
- Peterson and Peterson originally argued that the forgetting they found over their 3 to 18 second time delays occurred through trace decay.

Evaluation

- Pure trace decay is very difficult to test. Ideally no new information should be presented in the time between when the trace is acquired and when it is recalled to prevent confounding variables like displacement, yet Peterson and Peterson asked subjects to count backwards to stop them rehearsing.
- Reitman (1974) asked subjects to detect tones between presenting and recalling information, thinking this would hopefully prevent rehearsal without providing any new displacing material. Only about a quarter of information was forgotten after a 15 second delay which was more likely to be due to spontaneous trace decay than the Petersons' result.
- Baddeley and Scott (1971) concluded that 'something like trace decay occurs in the Peterson task, but is complete within five seconds, and is certainly not sufficiently large to explain the substantial forgetting that occurs in the standard paradigm' (quoted from Baddeley, 1997).

DISPLACEMENT THEORY

- Displacement theory seems to focus on explaining STM forgetting in terms of its limited capacity.
- Miller (1956) argued that the capacity of STM is approximately 7+/- 2 items of information. Despite the fact that these items can be chunked to increase their capacity, displacement theory suggests that there are only a fixed number of 'slots' for such information and that once they are full (capacity is reached) new information will push out or displace old material (which may be lost unless it was processed sufficiently to pass into LTM).
- In Peterson and Peterson's experiment, therefore, the increase of forgetting over time may have been a result of the counting backwards task increasingly displacing the original trigrams.

Evaluation

- Waugh and Norman (1965) used the ***serial probe technique*** where 16 digits are rapidly presented to subjects who are then given one of those digits (the probe) and have to report the digit which followed it. It was found that the nearer the end of the 16 digit sequence the probe was presented, the better was the recall of the following digit. This seems to support displacement theory since digits nearer the end of the sequence have fewer following digits to displace them.

Order of Sequence presented **3 7 2 9 0 4 5 6 3 1 9 0 7 8 2 6**

If probe = 8 then recall of digit (2) is good (little displacement)
If probe = 4 then recall of digit (5) is poor (greater displacement)

- The poorer recall (asymptote) shown in the middle of the serial position curve that results from free recall studies could similarly be attributed to displacement.

EVALUATION OF STM THEORIES OF FORGETTING

- In some of the research it is unclear what the relative influences of displacement and trace decay are on STM forgetting. Researchers such as Shallice (1967) have found that presenting digits at faster speeds in serial probe tests increases the ability to recall the digits presented earlier in the sequence. Thus trace decay may be responsible for some of the STM forgetting, since the faster presentation means the digits nearer the beginning of the sequence have less time to decay before being tested.
- It is also unclear how distinct the concepts of displacement and trace decay really are. For example displacement in STM works on the assumption that it has a limited capacity, which is measured in terms of memory span (usually 7+/-2 items or chunks). However Baddeley et al (1975) have shown that fewer words can be retained in STM if they take *longer* to pronounce. It seems STM capacity for words depends on the *duration* of pronunciation (how long it takes to say them) rather than the *number* of meaningfully chunked items – in this case words.
- Finally it is also unclear what is actually happening in trace decay and displacement to cause the forgetting. Is the trace really fading or, because it is so fragile, is it being degraded by other incoming information? Similarly with displacement, is the new material nudging aside, overwriting or distracting attention from the old material (or just making it harder to discriminate)? While ***interference theory*** has some of the same kinds of questions to answer, it has been more successful in explaining STM forgetting by showing how the ***similarity*** of competing information from the interpolated task used (as well as from previous trials) can affect the recall of the Petersons' trigrams (see interference theory).

10.8 Forgetting in long-term memory

INTERFERENCE THEORY
- One explanation of LTM forgetting is that over time more and more material will be stored and become confused together.
- Interference is most likely to occur between similar material.
- **Proactive interference** is where material learnt first interferes with material learnt later.
- **Retroactive interference** is where material learnt at a later time interferes with material learnt earlier.

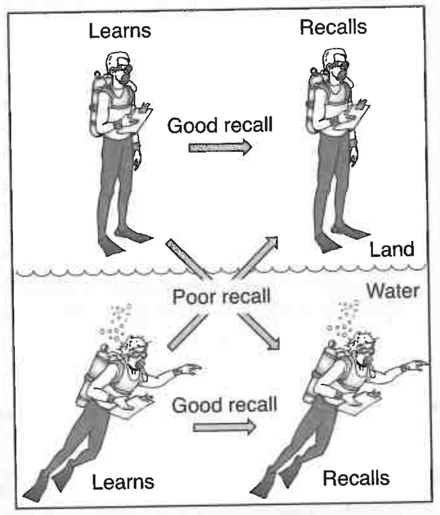
OLD MATERIAL — PROACTIVE INTERFERENCE → NEW MATERIAL
OLD MATERIAL ← RETROACTIVE INTERFERENCE — NEW MATERIAL

RESEARCH ON INTERFERENCE EFFECTS
- ***Proactive interference*** – Underwood (1957) found that the more nonsense syllable lists his students had previously learned, the greater their forgetting of new nonsense syllables was after a 24 hour delay. This was because the new nonsense syllables became increasingly confused with those from the old lists. Wickens *et al.* (1963) found subjects could be released from proactive interference effects by changing the nature (and thus reducing the similarity) of the new items to be learned, e.g. from nonsense syllables to numbers.
- ***Retroactive interference*** – McGeoch and Macdonald (1931) presented subjects who had learnt a list of words with various types of interference list to learn for ten minutes afterwards. Recall of the original words was then tested and those students given an interference list of ***similar meaning*** words recalled on average far less (12.5%) than those given unrelated words (21.7%) or nonsense syllables (25.8%). Best recall (45%) was gained for subjects who were given no interference test at all.

EVALUATION
1. **Artificiality** – Some of the research has been conducted using nonsense syllables often learned under artificially compressed laboratory conditions (rather than the more everyday distributed learning over time) and so interference theory has declined in popularity as an explanation of forgetting. However, many interference studies have been conducted with greater ecological validity, e.g. Baddeley and Hitch (1977) found rugby players' forgetting of the names of teams they had played depended more on interference from the number of rugby matches played since than on the passage of time.
2. **Applications** – Release from proactive interference has been applied by Gunter *et al.* (1981) to increase recall of news items by ensuring dissimilar items followed each other. Retroactive interference has been applied, e.g. by Loftus, to understand the effect of post-event information such as leading questions on the recall of eyewitness testimony.
3. **Reason for interference** – Some believe interference occurs when information is unlearned (Underwood, 1957) or over-written (Loftus, 1979) by other information. Tulving however, argues that interference of retrieval cues rather than stored material is responsible. Tulving and Pstoka (1971) found that the retroactive interference effect on a word list disappeared if cues (e.g. category headings of the words) were given for it.

CUE DEPENDENT RETRIEVAL FAILURE
Information may be ***available*** to recall but ***temporarily inaccessible***, for example:
- Tulving (1968) found that different items from a list might be recalled if people are tested on it on three separate occasions, probably because of the different cues present in each test.
- The tip of the tongue phenomenon. Brown and McNeill (1966) induced this 'state in which one cannot quite recall a familiar word' by reading definitions of infrequently encountered words and found the first letter and number of syllables could be identified before complete recall.

Memory **cues** or **prompts** may therefore be necessary to access information.



WHAT CUES AID RETRIEVAL?
Much research has investigated the type of cues that, depending upon their presence or absence, will determine retrieval failure.
- Tulving and Pearlstone (1966) studied intrinsic cues (those meaningfully related to the material to be remembered) by asking subjects to memorise lists of words from different categories. Subjects given the category headings as retrieval cues recalled more of the words than those who were not. Tulving proposed the ***encoding specificity principle*** to account for this – items committed to memory are encoded with the precise semantic context present at the time of learning.

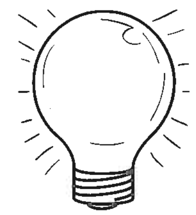
Evaluation – Thomson and Tulving (1970) confirmed this, but later research found cues not around at the time of learning can help too.
- **Context-dependent forgetting** is caused by the absence of ***external*** environmental cues that were present at the time of learning. Godden and Baddeley (1975) asked divers to learn word lists either on land or under water and found they recalled about 40% less in the opposite environmental context than in the same one. However, no effect was seen if a recognition test was used. Smith (1979) found more forgetting occurred a day later if subjects who had learnt 80 words in a distinctive basement room were then asked to recall them in a very differently furnished 5th floor room (12 words) compared to the original room (18 words). Interestingly, almost as many words were recalled (17.2) by a third group who sat in the 5th floor room but were asked to remember as much as they could about the basement room before recall.

Evaluation – Differences in environmental contexts have to be quite large before they significantly affect memory. However, imaginative context recreation can be applied to improve recall in eye-witness testimony.
- **State-dependent forgetting** is caused by the absence of ***internal*** bodily cues that were experienced at the time of learning. Bower (1981) found that his subjects recalled more memories learnt when sad if he tested them when hypnotised to be in a sad mood than a happy one. State-dependent effects have been found for alcohol (Goodwin et al, 1969) and other state-altering substances.

Evaluation – However, true state-dependent memory involving mood has not always been found for emotionally neutral information.

10.9 The role of emotion in forgetting

What effect do emotions have on forgetting?
Cognitive psychologists have sometimes neglected emotions in their models of memory, perhaps because of their focus on the information processing comparison with computers – who do not have them (yet!). However two concepts, repression and flashbulb memory, have created interest in the effect of emotion on memory – the first suggesting it could increase forgetting, the second that it could prevent it. Cognitive psychologists have tried to use their theories (e.g. of rehearsal, interference and cue dependency) to explain such emotional effects.



REPRESSION
- Repression is a concept from ***psychodynamic*** psychology which focuses heavily on emotion. Freud proposed that forgetting is ***motivated*** by the desire to ***avoid displeasure***, so embarrassing, unpleasant or anxiety-producing experiences are repressed – pushed down into the ***unconscious***.
- Repression is a protective ***defence mechanism*** that involves the ego actively blocking the conscious recall of memories – which become ***inaccessible***. Direct recall attempts will either fail, lead to distorted recall or digression from the topic. Psychoanalytic techniques, such as dream interpretation, free association etc., are necessary to access repressed memories.
- Freud argued that repression was the most important of defence mechanisms and that it not only accounted for his patients' anxiety disorders (the result of repressing more traumatic experiences) but was a common cause of everyday forgetting.

Evaluation
- Theoretically, forgetting more unpleasant than pleasant memories could just mean that people rehearse upsetting material less because they do not want to think, or talk to others, about it. It is also difficult to tell to what extent the repressor chooses not to search their memory or is unable to.
- Experimental evidence is difficult to gather due to the ethical problems of probing for traumatic memories or creating them by exposing subjects to unpleasant, anxiety-provoking experiences.
- Those studies that have been conducted show mixed results and, where negative emotions have been found to increase forgetting, there has been debate over the cause – emotion can affect memory without the need for an ego.
- Mild anxiety has been produced in the laboratory by giving false 'failure feedback', which does impair memory. However rather than causing repression, Holmes (1990) argues that it causes people to think about the failure which distracts attention away from the memory test (***interference theory***), since giving 'success feedback' also impairs recall.
- Higher anxiety was produced by Loftus and Burns (1982) who showed two groups a film of a bank robbery, but exposed one of the groups to a far more violent version where a young boy was shot in the face. The group that saw this version later showed far poorer recall of detail than the control group. Freud might have suggested repression, but Loftus (1987) could explain the forgetting with the ***weapons focus*** effect, where fearful or stressful aspects of a scene (e.g. the gun) channel attention towards the source of distress and away from other details. Alternatively people may need to be in the same state (i.e. anxious) to recall properly – this is a ***cue-dependent*** explanation.

FLASHBULB MEMORY
- Brown and Kulik (1977) suggested some events can be remembered in almost photographic detail – as if they are imprinted upon the mind. They called this type of recall 'flashbulb memory' and found it was most likely to occur when the event was not only surprising to the person but also had consequences for their own life.
- Thus they found around 90% of people reported flashbulb memories associated with personal shocking events, but whether they had such memories for public shocking events like assassinations depended upon how personally relevant the event was for them – 75% of black participants in their research had a flashbulb memory for the assassination of black-rights activist Martin Luther King, compared to 33% of white participants.
- Brown and Kulik (1977) argued that flashbulb memory was a ***special*** and ***distinct*** form of memory since:

1. The emotionally important event triggers a neural mechanism which causes it to be especially well imprinted into memory.
2. The memories were more detailed and accurate than most.
3. The structural form of the memory was very similar – people nearly always tended to recall where they were, what they were doing, who gave them the information, what they and others felt about it and what the immediate aftermath was, when they first knew of the event.

Evaluation
- Neisser (1982) however, disagrees that flashbulb memories are distinct from other episodic memories, since:

1. The long-lasting nature of the memory is probably due to it being frequently ***rehearsed*** (thought about and discussed afterwards) rather than being due to any special neural activity at the time. Existing memory theory, e.g. levels of processing, would explain meaningful and distinctive events lasting longer.
2. The accuracy of such memories has often been shown to be no different from most other events, e.g. McCloskey *et al.*'s (1988) study of memory after the Challenger space shuttle explosion and Wright's (1993) of the Hillsborough football tragedy.
3. The similar form of 'flashbulb memories' may just reflect the normal way people relate information about events to others.

Despite such criticisms some research still supports the notion of flashbulb memory. Conway *et al.* (1994) argue that studies that use events that are really relevant to peoples' lives (e.g. their own on Margaret Thatcher's resignation) find more accurate flashbulb memories over time. Cahill and McGaugh (1998) think that because it is adaptive to remember emotionally important events animals have evolved arousing hormones that help respond in the short term and aid storage of the event in the long term.

SO ARE THE EFFECTS OF EMOTION POSITIVE OR NEGATIVE ON MEMORY?
- Research findings are mixed, e.g. Levinger and Clark (1961) found free associations to emotional words (e.g. 'quarrel' and 'angry') harder to immediately recall. However, other researchers found that after a longer delay the effect reversed and the emotional words were recalled better. Generally positive long-term effects on memory are found for slightly above average levels of arousal (perhaps supporting flashbulb memory), but negative effects for very high levels of arousal. Typical laboratory studies only produce lower arousal levels and have not provided much support for everyday repression, whereas profound amnesia might result from very traumatic or long-term negative emotional arousal which cannot be laboratory-generated.

10.10 Strategies for memory improvement

RECOMMENDATION	RESEARCH BASED ON	EVALUATION
REPETITON • **Practice** makes perfect. The more times information is memorised, the more accurate the recall and the less time it takes to **re-learn** the material. Revise more than once!	• Ebbinghaus (1895) found re-learning savings – the greater the number of repetitions the less time it took to re-learn the lists. Since the majority of material was lost within the first day, perhaps the best time to test memory is after that time delay. Linton found that everyday memories last longer if they are occasionally remembered.	• Ebbinghaus only tested himself and used nonsense syllables. • Advertisers and psychologists have found that simple verbal repetition is not very effective. • Bekerian and Baddeley found that frequently repeated radio information did not produce strong memory.
ELABORATION • Information to be remembered should be made as **meaningful** as possible. New material will be remembered better if it is **integrated** with **existing** knowledge and if it is richly **associated** with other information.	• Craik and Tuiving found deep semantic level processing increased recall. • Morris *et al.* (1981) found that football fans recalled a list of football results far better than non football fans. The fans' interest and knowledge made the scores more meaningful and deeply processed. • Ley (1978) found patients remembered medical information better if they had existing background medical knowledge.	• Many mnemonic techniques work by creating associations with existing memories (the method of loci links items on a list to well known locations) or enriching associations (Bower, 1972), found linking material with vivid visual imagery is especially effective). These methods involve extra learning.
MEMORY CUES • Often memorising cues or **memory jogs** will **help access** larger amounts of information. **Recreating** the **conditions** under which material was learnt can act as a trigger for memory.	• Tulving and Pearlstone (1966) found that cues such as category headings could improve recall of lists of words under those headings. • Godden and Baddeley (1975) showed how state or context could act as a powerful memory jog when testing diver's recall of material under water and on land.	• Mnemonic techniques such as acronyms (like ROY.G.BIV to stand for the colours in the spectrum) or the peg word system and method of loci work by providing memory cues. • Freudian free association may also jog repressed memories.
ORGANISATION • Information is better remembered if it is **presented** in a **structured** way. The structure may aid recall by **linking** information in a **meaningful** way, **grouping** or **ordering** material more **manageably** or by taking advantage of the mind's existing ways of **representing** knowledge (for example in semantic categories).	• Bousfield found in free recall studies that information is automatically organised in LTM in semantic clusters. Bower *et al.* found higher recall for words organised in meaningful hierarchies. • Miller showed how the capacity of STM could be improved by organ-ising/chunking information into larger meaningful units, while many studies have supported the primacy/recency effect where word order affects memory.	• Ley et al (1973) found presenting medical information in a structured way improved patients' recall by 25%. • in a later study Ley (1978) found that many patients remembered the first information received better (the primacy effect). This finding and others were included in an advice booklet for doctors, which improved patients' recall of medical information by 15%.
IMPROVING CONSOLIDATION • Memory can be improved by limiting disruption to it (e.g. through preventing interference or trauma) or by strengthening it (e.g. through the use of memory enhancing drugs).	• Jenkins and Dallenbach (1924) found memory was less disturbed if material was learnt before going to sleep, while McGeoch and MacDonald (1931) found interference effects were greatest if two sets of information were learnt close together in time and were similar. • Cameron *et al.* (1963) has claimed that heavy doses of RNA can improve the memory of elderly people with memory difficulties, while a precursor of RNA, orotic acid, is commonly included in 'smart drugs'.	• Cameron's results were tainted by a lack of proper control data (perhaps memory improvement was due to a Hawthorne effect from the attention the elderly received) and replication failure. • While memory retention can be affected by drugs in laboratory animals, there is little evidence for smart drug effectiveness. • Caffeine may improve memory indirectly by increasing attention, or via a state dependent effect.

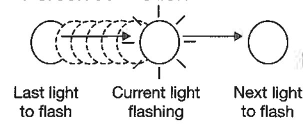
11.1 Visual perceptual organisation

GESTALT THEORY OF PERCEPTUAL ORGANISATION

Gestalt psychologists, such as Wertheimer and Koffka, believed that the brain possesses innate organisational properties with which it structures, orders and makes coherent sense of sensations from the environment.

EMERGENT PROPERTIES

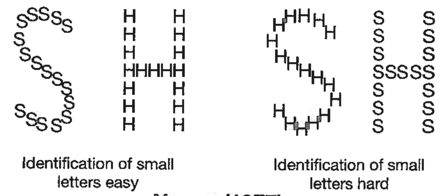
The organisation of environmental stimuli into groups produces **'emergent properties'** in them – that is to say, groups of stimuli have **'gestalt'** or 'whole' properties that produce perceptions that are more than the sum of the sensory stimuli that make them up (the whole is greater than the sum of its parts).



Wertheimer's phi phenomenon

Evidence

- Wertheimer's phi phenomenon – a series of separate lights turned off and on, one by one, in sequence will give the perception of continuous movement.
- Navon (1977) found, using figures like those opposite, that subjects were able to identify the large (whole) letter without being influenced by the smaller letters (parts) that made it up, but took longer to identify the smaller letters if the larger one did not correspond. This is evidence for the gestalt notion that the whole image is perceived before the parts that make it up.

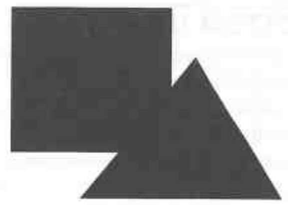


Navon (1977)

THE LAW OF PRAGNANZ

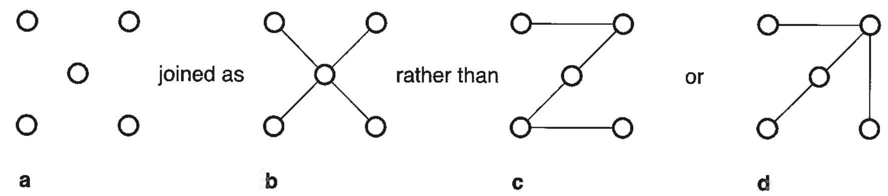
Gestalten (organised wholes) are derived from combinations of sensations via the **'Law of Pragnanz'** - the organisation of sensory stimuli will always follow the most simple or stable shape. The organisation will always be as 'good' as possible, so for example:

- The patterns or figures perceived will always be the ones requiring the least descriptive information.
- The unseen or missing parts of figures will be predicted from the seen parts in the most economical way.



Evidence

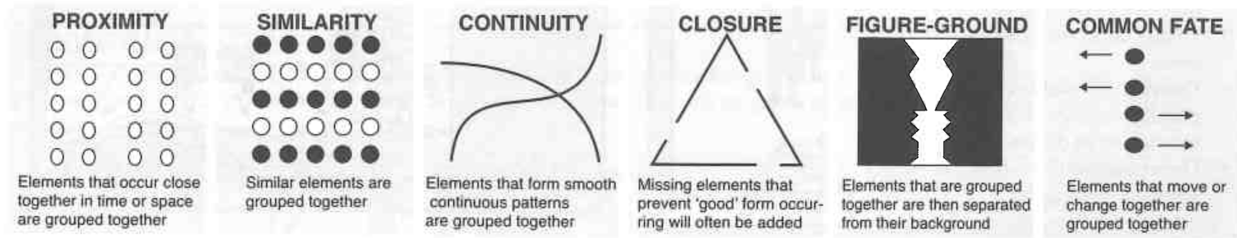
Pomerantz (1981) found that subjects would join dots in the same way to produce 'good', simple figures. For example, when shown the dots arranged in configuration 'a', subjects tended to join them as pattern 'b' rather than 'c' or 'd'.



Perception following 'good form'

This shape is perceived as a rectangle and a triangle rather than a complex 8-sided figure.

Pragnanz, and thus perceptual grouping and feature detection, is achieved through organising principles such as proximity, similarity, continuity, closure, figure-ground, and common fate.



EVALUATION

- Gestalt principles tended only to be applied to two-dimensional drawings rather than three-dimensional objects.
- However, Johansson (1975) found that subjects watching films of actors made completely invisible (by wearing black on a black background) except for dots of lights attached to their joints, could identify the actors' movements, posture and even gender. Cutting and Kozlowski (1977) even found subjects could identify their friends filmed under these conditions (requiring quite a degree of joining the dots!).
- The objects gestalt psychologists investigated were usually viewed in isolation, not as part of real scenes.
- Some gestalt concepts are rather vague – what is a 'good' figure and why?
- Gestalt psychology describes how features are grouped rather than explains.

Johansson (1975)