# 6 - Memory and cognitive aspects of mental health disorders
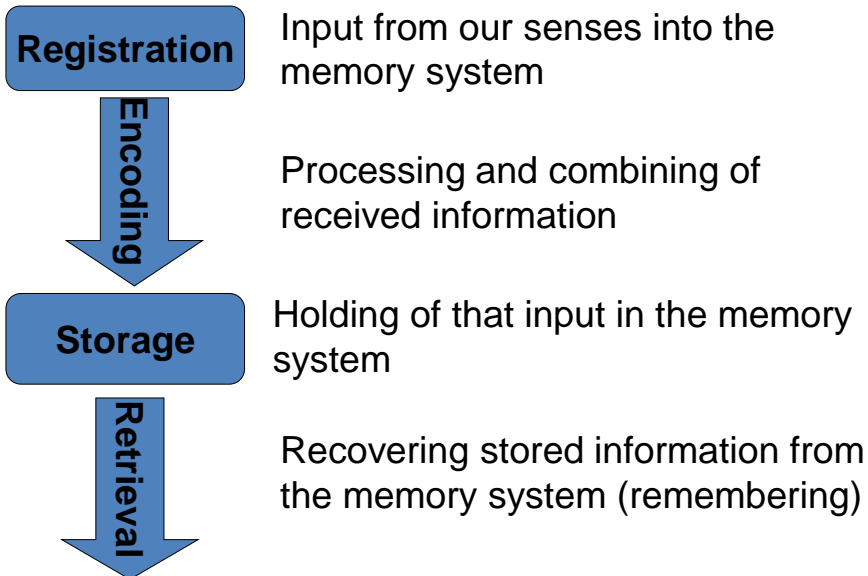
## Dr Stephen Gunning
## 22.05.2011

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# Learning Objectives

- Define memory and the processes of registration, encoding, storage and retrieval
- Describe the components of working memory
- Describe the different types of long-term memory
- Differentiate between effortful and automatic processing
- Define schema and explain how schemas enhance encoding and influence memory construction
- Define an associative network
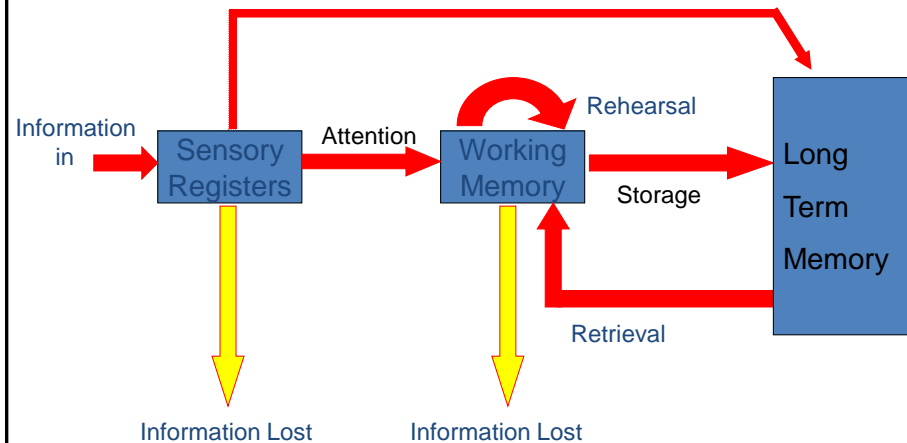- Outline the role of cognitive factors in depression

## Memory involves a number of stages:

**Registration** — Input from our senses into the memory system

**Encoding** — Processing and combining of received information

**Storage** — Holding of that input in the memory system

**Retrieval** — Recovering stored information from the memory system (remembering)

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## The Stage Model of Memory

- 3 classifications of memory based on duration of memory retention:
  - Sensory Memory
  - Working Memory
  - Long-term Memory

# A Model of Memory

Information in → Sensory Registers — Attention → Working Memory — Rehearsal ↺ — Storage → Long Term Memory — Retrieval

Sensory Registers ↓ Information Lost

Working Memory ↓ Information Lost

# Sensory Memory

- Sensory memory is the earliest stage of memory.

- Sensory information from the environment is stored for a very brief period of time (<1/2 sec for visual info; 3 or 4 sec for auditory info)
  – Contains more information than can be reported before the memory decays

- We don't attend to everything.

- Overwritten by subsequent perceptual information

- What we do attend to then passes into our working memory.

## Sensory memory

- Sperling (1960) asked subjects look at a blank screen. Then he flashed an array of 12 letters on the screen for one-twentieth of a second, arranged in the following pattern:
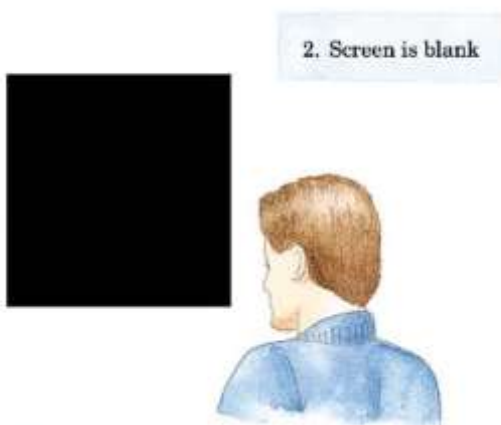
G  Z  E  P

R  K  O  D

B  T  X  F

- Participants were then asked to recall as many letters from the image as they could. Most could only recall four or five letters accurately. Subjects knew they had seen more letters, but they were unable to name them.

## Sperling's Memory Experiment

2. Screen is blank

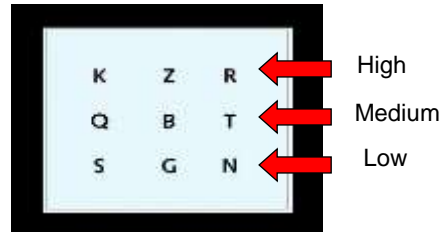## Sperling's Memory Experiment



## Sperling's Memory Experiment

# Sperling's Experiment

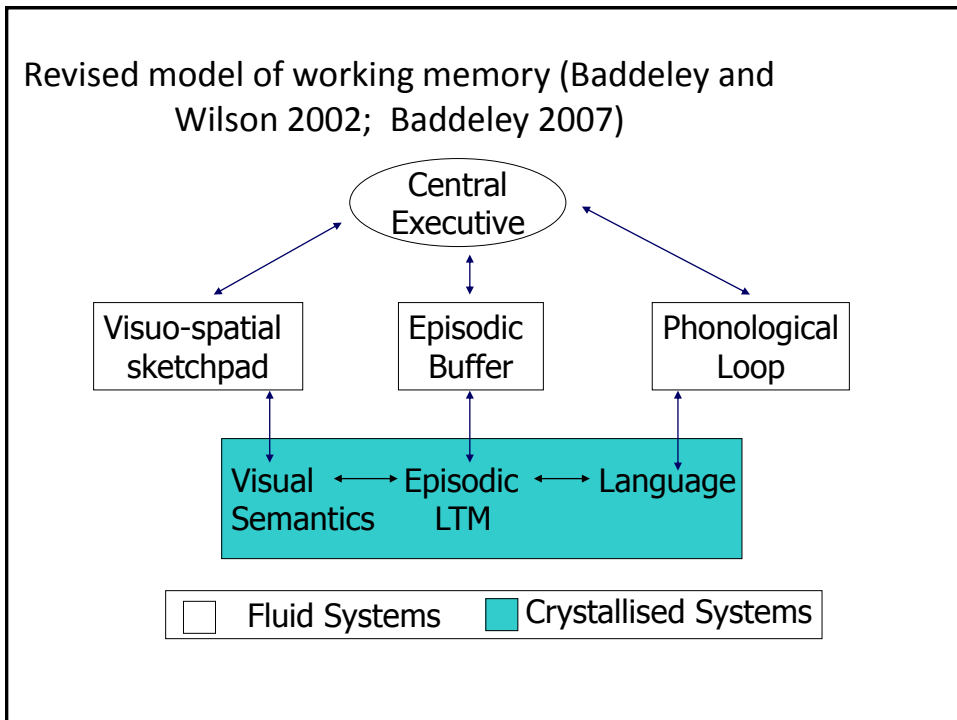- Sounded low, medium or high tone immediately after matrix disappeared
  - Tone signaled which row to report
  - Recall was almost perfect
- Memory for images fades after 1/3 second or so, making report of entire display hard to do



High
Medium
Low

# Working Memory

- A short-term memory store
- limited capacity in terms of information content NOT time
  - George Miller's 7 items ± 2
  - 7 for digits, 6 for letters, 5 for words

- Can remember more short words than long words

- Chunking allows more to be remembered

Revised model of working memory (Baddeley and Wilson 2002; Baddeley 2007)

Central Executive

| Visuo-spatial sketchpad | Episodic Buffer | Phonological Loop |

Visual Semantics ⟷ Episodic LTM ⟷ Language

☐ Fluid Systems   ◼ Crystallised Systems

# Central Executive

- Manipulation of information and direction of attention
- Suppression of irrelevant information and undesired actions
- Supervision of information integration
- Coordination of multiple tasks to be executed in parallel
- Co-ordination of the sub-systems of WM

# Working Memory

- Visuospatial Sketchpad
    - storage of visual and spatial information
    - e.g. for constructing and manipulating visual images, for the representation of mental maps
- Phonological loop
    - storage of auditory/verbal information
    - preventing decay by silently articulating contents, refreshing the information in a rehearsal loop
    - e.g. phone number

# Working Memory

- Episodic Buffer
    - Temporarily integrates phonological, visual, and spatial information, and possibly other forms (e.g., semantic, musical) in a unitary, *episodic* representation
    - Provides interface with episodic long-term memory

# Memorise this number

- 10661492185919141939196920122

# Working Memory

- Write down what you can remember

# Chunking

- Now try:


- 1066     1492        1859        1914
  1939         1969        2012
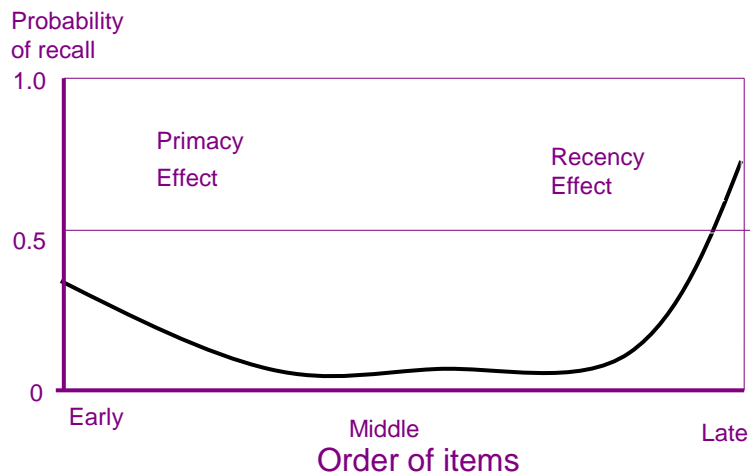
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# **Encoding**

- More effective encoding into long-term memory increases the likelihood of retrieval
- *Effortful Processing*:
  - initiated intentionally
  - requires conscious attention
- *Automatic Processing*
  - occurs without intention
  - requires minimal attention

# Depth of processing

- In 1975 Canadian psychologists Fergus Craik and Endel Tulving conducted a set of experiments that demonstrated this effect. The experimenters asked subjects to answer questions about a series of words, such as *bear,* which were flashed one at a time. For each word, subjects were asked one of three types of questions, each requiring a different level of processing or analysis.

- 1) asked about the word's visual appearance: "Is the word in upper case letters?"

- 2) asked to focus on the sound of the word: "Does it rhyme with *chair*?"
Or
- 3) to think about the meaning of the word: "Is it an animal?"

- When subjects were later given a recognition test for the words they had seen, they were poor at recognizing words they had encoded superficially by visual appearance or sound. They were far better at recognizing words they had encoded for meaning

# Word List

## The Serial Position Effect

Probability of recall

1.0

Primacy Effect

Recency Effect

0.5

0

Early

Middle

Late

Order of items

---

- The probability of recalling a word is related to
  - Order in the list - serial position effect
  - Personal salience of words
- Predict that you remembered
  - House, Rabbit, Shoe (primacy)
  - Road, Finger, Sponge (recency)
  - Doctor (salience)

# The list!

- House
- Rabbit
- Shoe
- Spade
- Banana
- Chair
- Suitcase
- Doctor

- Towel
- Plate
- Tomato
- Earring
- Road
- Finger
- Sponge

# Committing information to memory

- 1. Rote
  - Frequent repetition (verbal)
  - Forms a separate schema, not closely linked to existing knowledge
  - Least efficient
  - Less deep processing

- 2. Assimilation
  - Fitting new information into existing schema(s)
  - Learning by comprehension
  - Can only be used where there is link between old and new knowledge
  - Deep processing
  - Wholly Declarative

- 3. Mnemonic device
  - Artificial structure for reorganising or encoding information to make it easier to remember
  - Useful when info doesn't fit existing into schemas
  - Examples: hierarchies, chunking, visual imagery, acronyms
  - Need to recall artificial structure to access information

**Retrieval**

- Failed retrieval does <u>not</u> always mean that information is lost from memory
- Internal or external *retrieval cue* can activate information stored in long-term memory
- Multiple cues enhance retrieval
- Conscious (effortful) or unconscious (automatic)

# Storage

- *Associative Network*
- Each concept represented by a node
- Activation of one network leads to *spreading activation* of related concepts

# Associative network
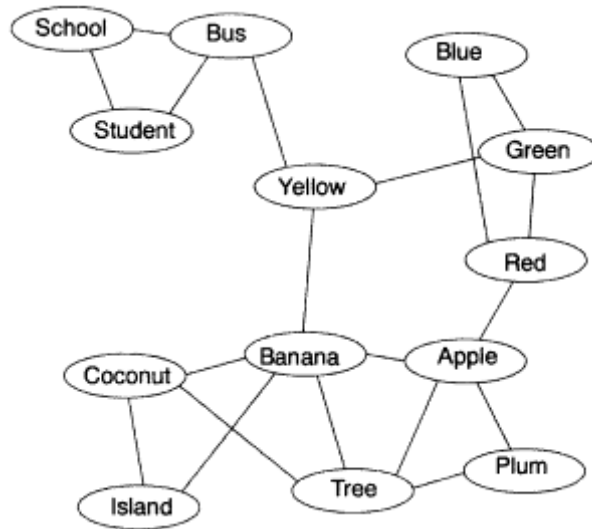


# Storage

- There is more than one type of memory store
- Each has its own performance characteristics and function
- Each is the function of a different neuroanatomical system

# Taxonomy of Memory

Cohen and Squire, 1980

Memory

Declarative

Non-declarative

- Available to conscious retrieval

- Can be declared (propositional)

- Examples
  – "What did I eat for breakfast?" (episodic)
  – "What is the capital of Spain?" (semantic)
  – "What did I just say?" (working)

- Experience-induced change in behaviour

- Cannot be declared (procedural)

- Examples
  – Advertising (Priming)
  – How to ride a bicycle (skills)
  – Phobias (conditioning)

# Taxonomy of Memory

Memory

Declarative

Non-declarative

Episodic   Semantic   Working

Priming   Procedural   Conditioning

# Neural correlates of memory

- The hippocampus has an important role in the formation of new episodic or autobiogrpahical memories (eg: Squire, Eichenbaum,O'Keefe). Some researchers prefer to consider the hippocampus as part of a larger **medial temporal lobe** memory system responsible for general declarative memory.



# Hippocampus



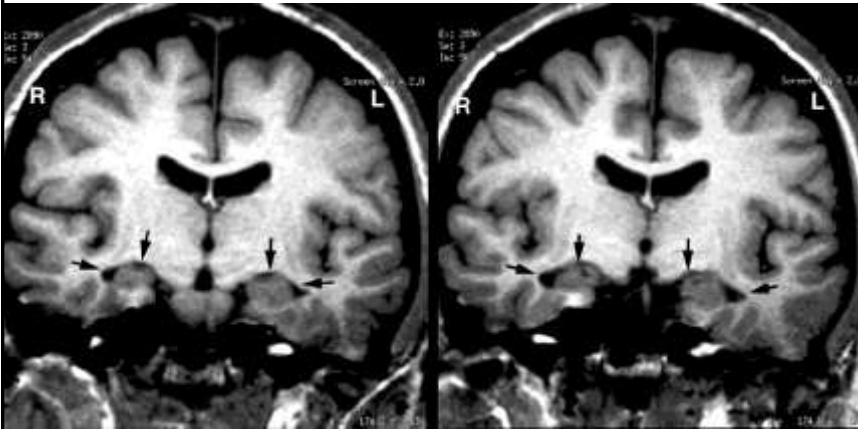**http://commons.wikimedia.org/wiki/File:Hippocampus-mri.jpg**
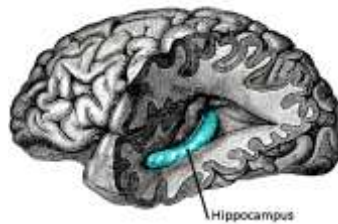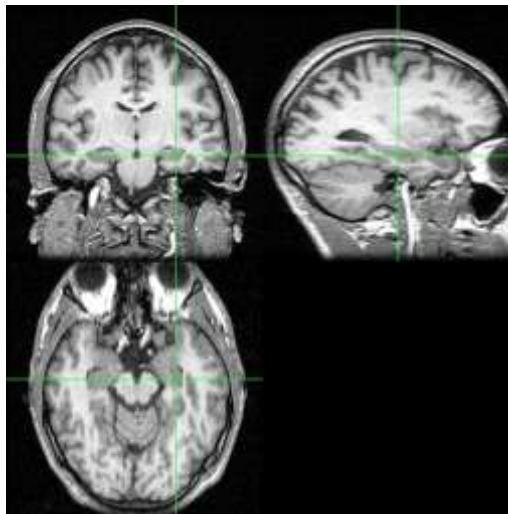
# Bilateral atrophy of hippocampus



# Clive W

- Musician, composer, scholar
- Herpes simplex encephalitis at age 46.
- Medial temporal lobe damage.
- Severe amnesia.
- Permanent state of just having woken up.

**Navigation-related structural change in the hippocampi of taxi drivers**

Maguire et al. 2000 *Proc Natl Acad Sci U S A.* 2000 April 11; 97(8): 4398–4403

- Looked at structural MRIs of licensed London taxi drivers compared with those of control subjects who did not drive taxis.
- The posterior hippocampi of taxi drivers were significantly larger relative to those of control subjects.
- Hippocampal volume correlated with the amount of time spent as a taxi driver (positively in the posterior and negatively in the anterior hippocampus).

# Neural correlates of memory

- In Alzheimer's disease the hippocampus is one of the first regions of the brain to suffer damage; thus memory problems and disorientation appear among the first symptoms.

- Damage to the hippocampus can also result from anoxia, encephalitis or medial temporal lobe epilepsy.

# Schemas

- a mental structure that represents some aspect of the world
- used to organize current knowledge and provide a framework for future understanding
- Automatic not effortful thought
- e.g. stereotypes, door schema
- *Expertise:* process of developing schemas that help encode information into meaningful patterns

# Schemas

- Brewer and Treyens (1981) demonstrated that the schema-driven expectation of the presence of an object was sometimes sufficient to trigger its erroneous recollection.
- An experiment was conducted where participants were requested to wait in a room identified as an academic's study and were later asked about the room's contents.
- A number of the participants recalled having seen books in the study whereas none were present.

# Define the misinformation effect

– Distortion of a memory by misleading post-event information (role of schema?)
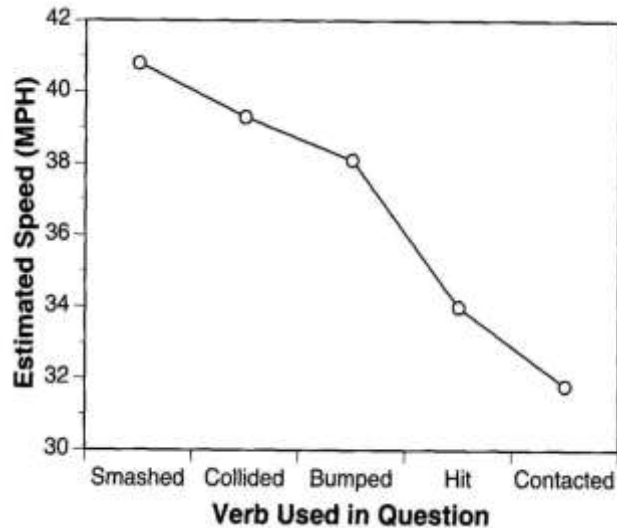
Example: Eyewitness testimony

– Loftus tested whether the language used to question witnesses can change what they actually remembered.

– Subjects see a film depicting car accident or other naturalistic eyewitness event

# Car crash

"How fast were the cars going when they Smashed/Collided/Bumped/Hit/Contacted each other?"

## Loftus & Palmer (1974)



# Eyewitness Testimony

One week later, participants were asked if they had seen any broken glass. Although there was no broken glass, 32% of the 'smashed' condition said they had compared to only 14% of the 'hit' condition.

## False Memory



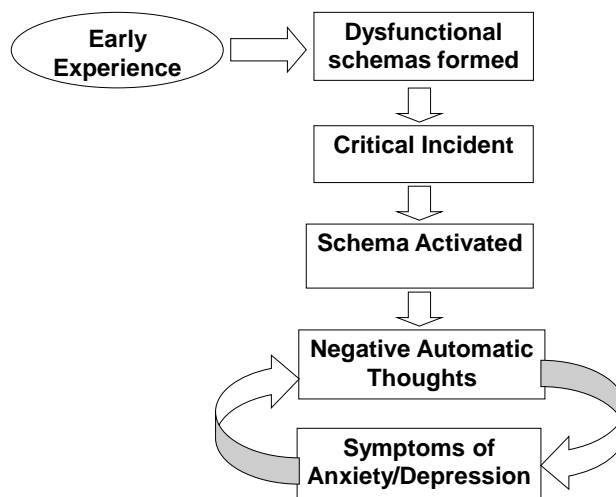(Braun, Ellis & Loftus, 2002)

## False Memories

- Of those that remember meeting Bugs:
  - 62% said they shook his hand
  - 46% remembered hugging him
  - Others remembered touching his ear or tail,
  - or even hearing him speak ("What's up, Doc?").
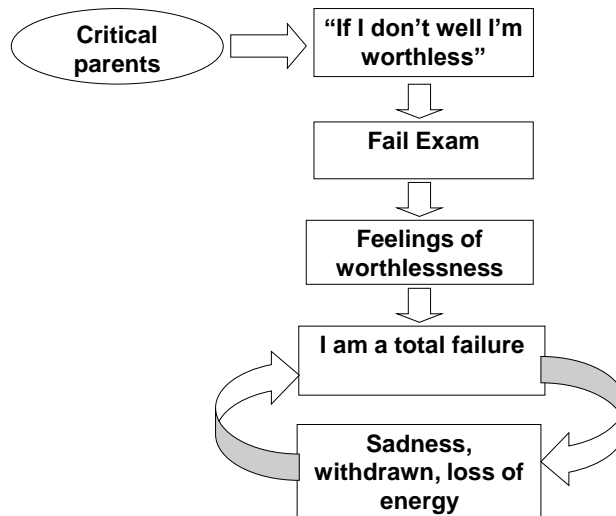
## Beck (1963) Thinking and depression

- Recorded psychotherapy sessions with 50 depressed patients.

- Identified three recurring themes in the content

  - Self – e.g. I'm useless
  - World – e.g. My life is unfulfilling
  - Future – e.g. Things will never get better

- These became known as the depressive triad

## Beck's schema theory

# Beck's schema theory

```
┌──────────┐         ┌─────────────────┐
│ Critical │   ═══>  │ "If I don't well │
│ parents  │         │  I'm worthless"  │
└──────────┘         └─────────────────┘
                              │
                              ▼
                     ┌─────────────────┐
                     │    Fail Exam    │
                     └─────────────────┘
                              │
                              ▼
                     ┌─────────────────┐
                     │   Feelings of   │
                     │  worthlessness  │
                     └─────────────────┘
                              │
                              ▼
                  ┌─────────────────────┐
              ┌──>│ I am a total failure │──┐
              │   └─────────────────────┘  │
              │                            │
              │   ┌─────────────────────┐  │
              └───│     Sadness,        │<─┘
                  │  withdrawn, loss of │
                  │       energy        │
                  └─────────────────────┘
```

# Negative Thinking Traps

LABELLING: Place a fixed, global label on oneself without considering evidence that leads to a less disastrous conclusion
"I'm a loser" ; "I'm no good."

OVERGENERALIZATION: Drawing general conclusion based on single incident
"I felt nervous with others at the party; I don't think I have what it takes to make friends."

PERSONALIZATION: Inappropriately relating external events to oneself without an obvious basis for making such connections
"She didn't say hello to me because I must have done something wrong."

DICHOTOMOUS THINKING: View a situation in only two categories instead of on a continuum
"If I'm not a total success, I'm a failure"

52

# The effect of induced mood on recall
(Teasdale et al 1980)

Subjects: 43 undergraduate students

Procedure:

- S's underwent Velten mood induction procedure to induce both elated and depressed mood.

- Presented with series of words e.g. "train, water, meeting" and asked to recall an personal experience related to that word.

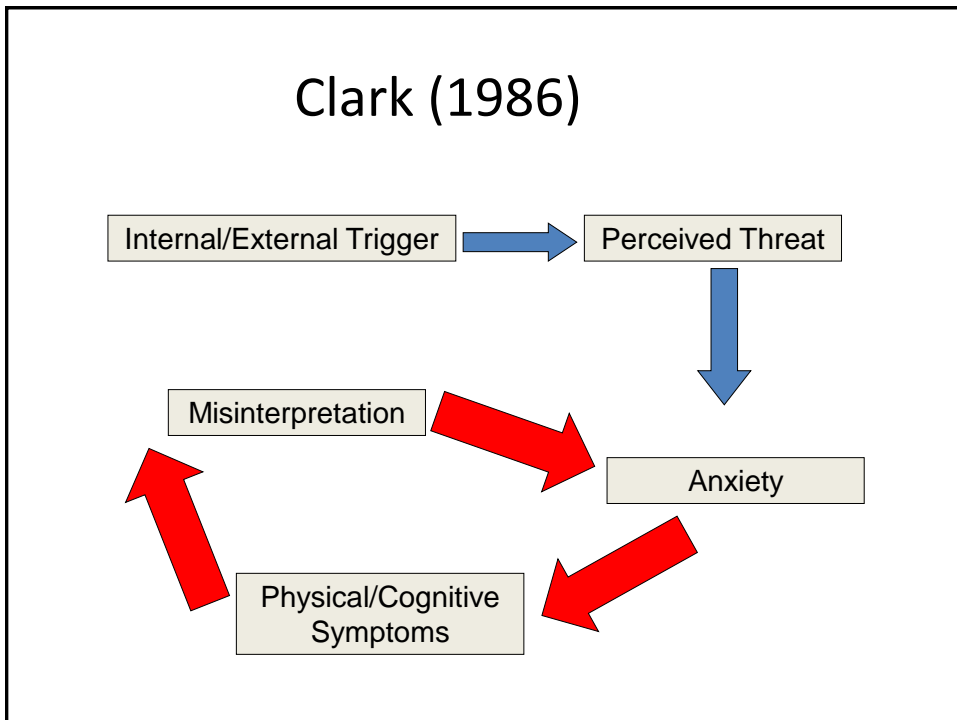- S's then rated memories on a happy-unhappy scale.

Effect of induced mood on memory (Teasdale et al (1980)



Legend:
- % Happy memories
- % Unhappy memories

**Effect of induced mood on recall**
(Teasdale et al 1980)
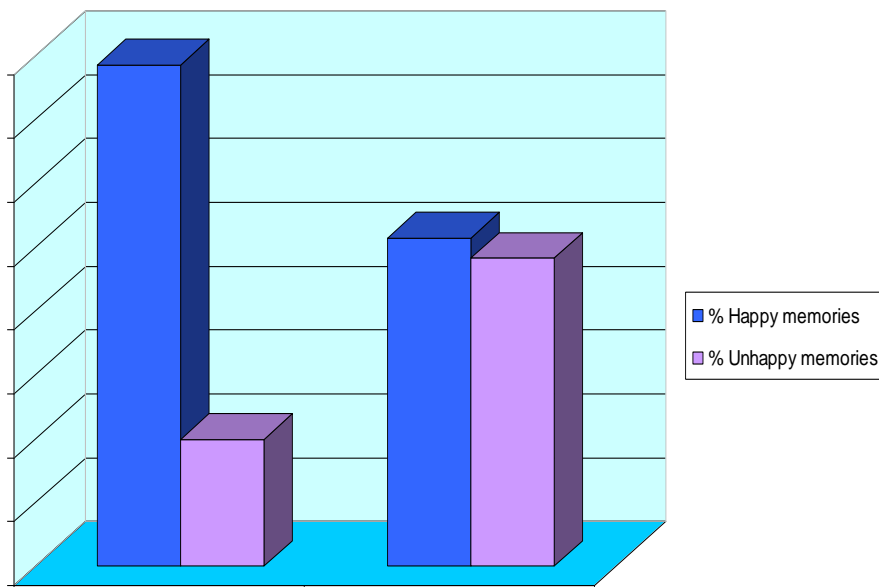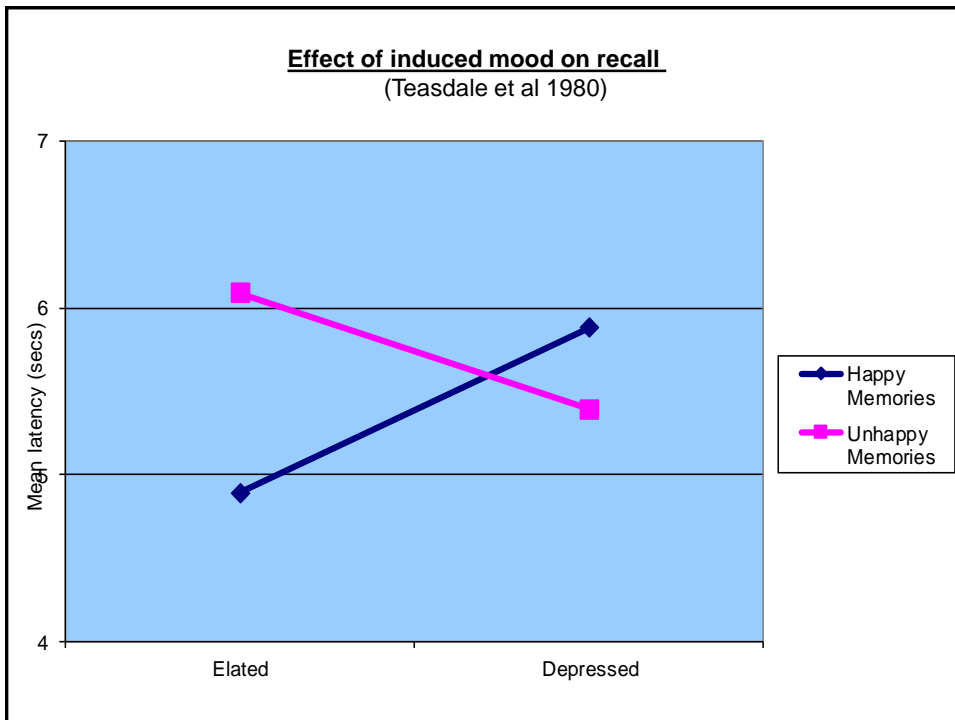


# Clark's (1986) theory of catastrophic interpretation

- Individuals with PD interpret certain bodily sensations in a catastrophic fashion
- Sensations (esp. those involved in normal anxiety responses e.g., palpitations, breathlessness, dizziness, paresthesias) are considered to be a sign of impending physical or psychological disaster
- e.g. palpitations → having heart attack

## Clark (1986)

Internal/External Trigger → Perceived Threat

Misinterpretation

Anxiety

Physical/Cognitive Symptoms

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## Clarke's (1986) theory of catastrophic interpretation

- 7–28% of population will experience an occasional unexpected panic attack

- Only go on to develop PD if they develop a tendency to interpret in a catastrophic fashion

- Studies demonstrate that PD can be alleviated with cognitive techniques e.g. cognitive restructuring
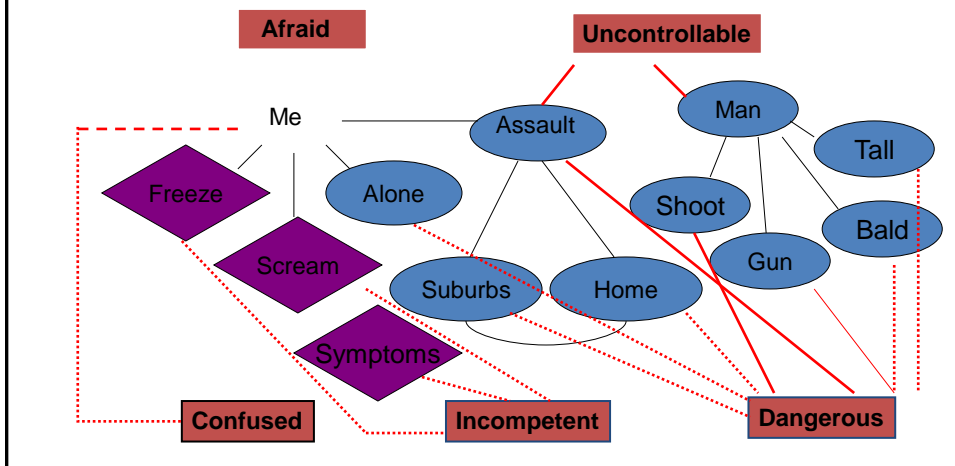
# Post – Traumatic Stress Disorder

3 Main symptom groups of symptoms:

- **Re-experiencing:** e.g. flashbacks, nightmares.

- **Avoidance:** e.g Behavioural and cognitive avoidance, numbing, detachment.

- **Hyperarousal:** Hypervigilence, exaggerated startle response.

# Schematic model of normal memory of a sexual assault
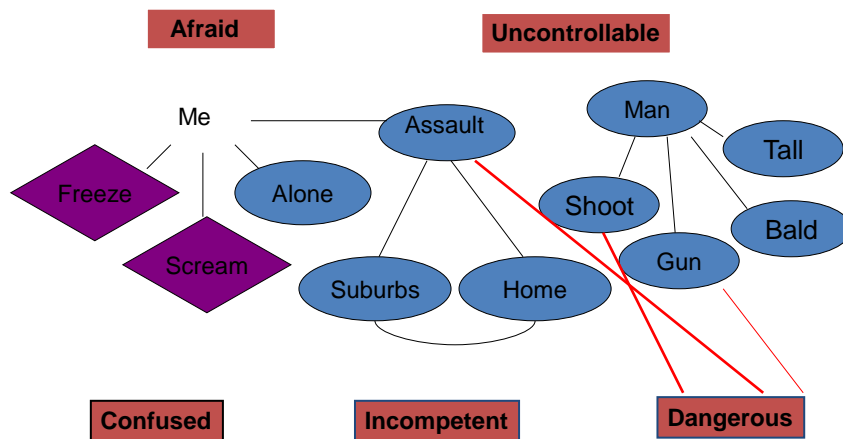
## Schematic model of a pathological memory of a sexual assault



# Evidence Base for CBT

|  | Recovery Rate |
|---|---|
| • All Anxiety Disorders | 71% |
| • Panic disorder | 75% |
| • Posttraumatic stress disorder | 75% |
| • Social Phobia | 76% |
| • Generalised anxiety disorder | 69% |
| • Obsessive compulsive disorder | 49% |
| • Specific Phobias | 81% |
| • Major depressive disorder | 60% |

# CBT vs Medication

- CBT has been shown to have significantly lower relapse rates than anti-depressant medications.
- Panic disorder:          5%    vs  40%
- Social Phobia:             0%    vs  33%
- OCD:               12%  vs  45%
- Depression          45%  vs  86%

# NICE guidelines

- CBT recommended as first line treatment for:
  Depression,
  Social anxiety,
  PTSD,
  Generalised anxiety disorder,
  OCD,
  Bulimia,
  Panic disorder and specific phobia
  (see NICE at www.nice.org.uk)