

# Fear conditioning and anxiety disorders

By  
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## Introduction

- Two anxiety disorders: PTSD, OCD
  - symptoms
  - physiology
- Fear conditioning perspective
- Role of amygdala and hippocampus
- Some explanatory models
- Influence of implicit memory on behaviour

## LeDoux (1994):

"Many human mental disorders - including anxiety, phobia, PTSD and panic attack - involve malfunctions in the brain's ability to control fear"

*the fear conditioning process could be implicated in various mental disorders*

## My question:

Could the concept of dual pathways help us to understand two common and debilitating anxiety disorders:

- Posttraumatic stress disorder (PTSD)
- Obsessive-compulsive disorder (OCD)

## PTSD and OCD

Both are appearing more frequently in the media in recent years:

e.g., films  
television series

Several major characters (real or fictitious) are acknowledged as having symptoms of either PTSD or OCD

## PTSD and OCD in the media

### Good:

- out in the open
- normalisation
- encourages discussion
- public interest

### Bad:

- distortion or misrepresentation of symptoms
- no explanatory aspects
- "freak show" element
- not always psychologically informed

## PTSD

Many British WW2 films about soldiers (especially prisoners of war) illustrate PTSD, showing e.g., scenes with flashbacks:

### e.g. *Prisoners in Time* (1995):

about a man who develops PTSD after being tortured in a Japanese Prisoner of War camp

he has a flashback on a train in Thailand many years later, when he sees a ticket collector in uniform

## PTSD

### e.g., *Regeneration* (1997)

The story of Dr. William Rivers and his experimental (and at the time radical) new treatment programme for PTSD (then known as "shell-shock") at Craiglockhart Hospital in Scotland -i.e., psychotherapy - during WW1



USA version: *Behind the Lines*

## Regeneration (1997)



Siegfried Sassoon



Wilfred Owen

It is also the story of two famous poets from the first world war, Wilfred Owen and Siegfried Sassoon: they met at Craiglockhart Hospital, after being sent there with "shell shock"

## PTSD

Several Hollywood films show Vietnam veterans with symptoms of PTSD:

### e.g., *The Deer Hunter* (1979)

Christopher Walken plays a Vietnam soldier traumatised by his experiences: he is shown as unresponsive and unable to speak, addicted to drugs (self-medicating), voluntarily playing Russian roulette whilst emotionally numb

## PTSD

### e.g., *Taxi Driver* (1976)

Robert de Niro plays a Vietnam veteran with classic symptoms of PTSD:

- depression
- loneliness
- insomnia
- more comfortable going out at night: takes a job working night-shifts as a taxi driver
- feelings of helplessness
- inappropriate social behaviour

## OCD

### Hollywood does OCD:

Recently some films have appeared about characters who display OCD symptoms

### e.g., *As Good as It Gets* (1997)

- Jack Nicholson plays a successful writer with OCD
- Shower scene (takes forever)
  - Restaurant scene (has to have table setting done in exactly the same way every day)

## OCD

e.g., **The Aviator (2004)**

Leonardo di Caprio plays Howard Hughes, who famously had *OCD*

- Washroom scene (uses all the paper towels, then has no way to open the door)
- Gets stuck on reciting words
- Refuses to come out of a room in his house or let anyone in

## OCD

**The BBC does OCD:**

- **Dirty Filthy Love (2004)**
  - Shown on TV1/Rialto
  - May also be available at video store (if you feel brave enough to ask for it!)

## Dirty Filthy Love (2004)



- A film about a man who suddenly develops *OCD* and Tourette's Syndrome
- He joins a self-help group after meeting a woman with *OCD*
- A moving portrayal of daily life coping with *OCD*
- Depicts people with *OCD* in sympathetic, positive light
- Also humorous in places

## Monk

- A U.S. television comedy series:
  - Adrian Monk: "the defective detective"
- Very popular and successful:
  - Emmy-award winning
  - Currently in its sixth season

The usanetwork even has a Monk website

## Mr. Adrian Monk



## Mr. Monk and the Website

An obsessive-compulsive's dream site:

- Very detailed
- Phobia of the day
- Message boards where fans share their phobias
- Phobia dictionary
- "Monk shui" game
- Much more....

It has become a kind of self-help website

- *Suggests great interest in this issue*

## Friends: Monica

- Has some obsessive compulsive tendencies (never named as such):
  - particular about tidiness, how things have to be done
- These tendencies become well-known among the friends, as does the necessity not to "set her off" by accidentally aggravating them (standing joke)
- The series was first broadcast much earlier than Monk, when such things were not explicitly named/depicted/discussed

## Monica



## OCD: What is it?

### Obsessive-compulsive disorder:

an anxiety disorder that can occur in response to a traumatic event

### Characterised by:

- Unwanted intrusive repetitive thoughts or impulses (cause anxiety)
- Compulsive behaviours (attempts to reduce anxiety)

## OCD: What is it?

### Unwanted intrusive repetitive thoughts:

- e.g.
- \* fear of contamination
  - \* fear of causing disaster by forgetting to turn off taps, close windows, etc

### These lead to compulsive behaviours:

- e.g.
- \* avoiding sources of "contamination"
  - \* frequently hand-washing, showering, doing laundry
  - \* frequently checking taps, gas taps, windows

## Contradictory Symptoms: PTSD

### Simultaneous:

- *numbed* responsiveness
- *hyperarousal* in response to emotionally arousing stimuli
- very *vivid* and detailed traumatic *memories*
- total *amnesia* for the traumatic experience

## Trauma memories :

### Can be

- vague / vivid
- intrusive / quiescent
- under control / out of control
- experienced in past / in present

Many examples exist of patients who have forgotten their traumatic experience but whose behaviour is influenced by it

## PTSD: What is it?

### Posttraumatic stress disorder:

an anxiety disorder that can occur in response to a traumatic event

### Characterised by:

- Flashbacks (re-experiencing the event)
- Avoiding reminders of the event
- Hyperarousal (e.g., exaggerated startle response)

## Flashbacks

- highly perceptual
- exceptionally clear and vivid
- elicited automatically
- under limited conscious control
- stereotyped and unchanging, even after multiple recalls
- involve subjective time distortions: re-experienced in the present

*Suggests an image-based memory which is not dependent on the hippocampus*

## Contradictory Symptoms: OCD

Person knows the fear and compulsion are senseless, and may even try to resist:

*but still can't stop doing it*

Cleanliness obsession:

*with concomitant slovenliness*

Checking compulsion:

*leads to greater doubt*

## Opposites!

What exactly is going on here?

Could the concept of dual pathways help to explain this?

## Physiology of PTSD

### Decreased hippocampal volume:

studies indicate reductions ranging from 7-8% to 22-26% in Vietnam war veterans and in women repeatedly abused as children

## Physiology of PTSD

### During flashbacks:

- heightened activity in amygdala / right hemisphere
  - affects processing of **emotions**, **visual images**
- simultaneous decrease in activity of Broca's area in left hemisphere
  - affects processing of **language**

*Suggests* during a flashback, sensory elements of experience are perceived, but difficult to put into words

## Physiology of OCD

### MRI scans in humans show:

- reduced amygdala volumes
- hippocampal abnormalities
- absence of normal hemispheric asymmetry of hippocampus - amygdala complex

### Experiments with rats show:

- severe damage to hippocampus can cause:
  - \* stereotyped behaviour
  - \* invariable and excessive behaviour

## Physiology of OCD

### Evidence of impaired:

- visuospatial memory
- non-verbal information processing
- memory for actions

### NO evidence of impaired:

- verbal memory
- verbal information processing

## Similarities between PTSD/OCD

- Anxiety disorders
- Can occur in response to a traumatic experience
- Recurrent unwanted intrusive thoughts, images, impulses
- Can occur together
  - *Vietnam veterans / abused women*
- Risk of OCD much greater for people with PTSD
  - *Vietnam war veterans with high combat exposure have dramatically increased incidence of OCD*
  - *Childhood trauma increases risk of developing OCD*

## Traumatic events

People may experience many kinds of traumatic event

e.g., large-scale or unusual events:

- acts of violence (e.g., shootings, bombings)
- extreme environmental events (e.g., tsunamis, hurricanes)
- wars, famines

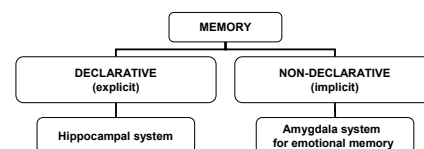
Such events seem to form a constant backdrop to daily life

## Traumatic events

But common personal misfortunes can also be traumatic:

- bereavement
- divorce and other relationship breakdowns
- accidents
- various kinds of abuse
- illness, operations
- adverse situations or events at home, school, work
- personal attacks, home invasion

## Types of memory



## Emotional memory (LeDoux)

### Explicit memory system:

forms a memory about emotion:

- can be consciously recollected later

### Implicit memory system:

forms an "emotional memory" (*an implicit memory of an emotional event*):

- automatically elicited by trigger stimuli in situations similar to original one
- conscious recall not required

## Emotional memories

- Think of a particularly important time in your life
  - For me: the summer I left high school
- Think of a song that was being played all the time back then, but which you haven't heard for a long time
- Find a videoclip of it on YouTube
- Watch the videoclip

## Emotional memories

- an amazingly powerful and evocative experience:
  - almost like being taken back in time
  - like being "that person" again
- check out the comments left by others:
  - "Like being transported right back to my teens"
  - "Has it really been 30 years?! Give me my life back!"
  - "This takes me right back!"
- music: very evocative sensory experience

**The past is  
another country...  
Or is it?**

## Living in the past:

We can spend quite a lot of time doing this now:

- Endless reruns of old T.V. series (e.g., U.K.T.V., Vibe)
- Nostalgia radio channels (e.g., Greatest Hits)
- Videos, CDs, DVDs (e.g., YouTube)
- Archive material (e.g., family history, war records, etc)
- Repeated showings of old films (e.g., M.G.M.)
- Nostalgia websites (e.g., FriendsReunited, etc)
- Family tree research websites

We live in very well-recorded times...

## Trauma memories

- Usually begin as disjointed fragments, which focus on sensory and perceptual aspects of the experience
  - > **non-verbal (perceptual) memory initially**
    - > e.g., *flashbacks*
- Over time, person becomes able to construct a narrative memory, with more contextual details
  - > **verbal memory comes later**
    - > e.g., *can talk about it*

## Joseph LeDoux



has been at the forefront of research on the fear conditioning system

## Fear conditioning: parallel pathways

### Direct (subcortical) pathway

- shorter, faster
- restricted stimulus representation
- lower-level processing

= "quick and dirty" pathway:  
→ reaches amygdala and activates defense responses quickly

### Indirect (cortical) pathway

- longer, slower
- more detailed / accurate stimulus representation
- higher-level processing

## The amygdala

- Crucial in modulating emotion
  - Hub of the neural circuits that process emotion in the brain
  - Modulates activity in the cortex (especially *prefrontal cortex*)

## The amygdala and fear

### Joseph LeDoux (1996):

- the amygdala lies at the core of a complex set of neural circuits that process emotion
- sensory inputs that elicit emotions arrive in the *thalamus*:
  - this emotional information is then carried **simultaneously** along *two separate pathways*:
    - a pathway to the **amygdala**: **FAST**
    - a pathway to areas in the **cortex**: **SLOW**

## The amygdala and fear

- **The amygdala**
  - processes the information quickly
  - if it detects a threat: immediately triggers neural activity that leads to autonomic arousal and endocrine (hormonal) responses associated with emotion
  - located near the thalamus
  - **The amygdala pathway:**
  - extremely fast processing
  - emotions may be triggered even before the brain has a chance to "think" about the input
- reacts to the situation impulsively (without thinking)*

## The amygdala and fear

- **The cortex:**
  - more leisurely cognitive appraisal of the information
  - located further away from the thalamus
  - **The cortical pathway:**
  - slower processing
  - encodes more details about a potential threat, and evaluates the threat more carefully and thoroughly
  - then sends additional information to the amygdala
- makes sense of the situation*



## The amygdala and fear

### Amygdala pathway:

- extremely fast information processing
- almost instant emotional response to threat: autonomic arousal and endocrine (hormonal) responses
- emotions may be triggered before brain can react
- may be important for survival
- amygdala close to thalamus

### Cortical pathway:

- slower information processing
- cognitive appraisal of the information
- encoding of details about a potential threat
- more thorough evaluation of the threat
- sends additional info to the amygdala
- cortex distant from thalamus

## The amygdala and fear

**EXAMPLE:** *As I drive along Knighton Road, a car suddenly reverses out of a driveway, across the road, and into my path:*

1. I see the car coming towards me (**stimulus**)
2. This information is sent to the **thalamus**
3. Information is sent **directly** to the **amygdala** (**fast** route):
4. Immediate reaction: autonomic arousal / hormonal response:
  - *I slam on the brakes, start shaking; my heart pounds, my blood is pumping*
5. Information is also sent on **indirectly** to the **visual cortex** (**slow** route): time to think about the danger
6. Slower reaction:
  - *I calm down, and check out my situation: did I avoid a collision? Am I o.k.? Is the other driver o.k.? Is my car o.k.? Was anyone behind me? Are they o.k.? I'd better restart the car and get moving. Crazy driver!*

## The amygdala and fear

**EXAMPLE:** *Walking home down a dark deserted street alone one night, I suddenly hear a rustle behind me...*

### Amygdala reacts: autonomic / hormonal response

- blood pressure surges, heart rate goes up, mouth is dry, vision restricted, pulse beating, senses heightened
- *let's get out of here quick! run for it!*

### Cortex thinks it over:

- considers details of the event:
- *am I overreacting? has anyone followed me? is it safer where I am now? was there actually a threat? what was that all about? should I have got a taxi? should I avoid this situation in future?*

## The amygdala and fear

### • LeDoux (1996):

- The rapid response pathway evolved because it is a highly adaptive warning system that may save our life
- In situations of danger, it is useful to be able to respond quickly
- The time saved by the amygdala acting on the thalamic information, instead of waiting for the cortical input, may be the difference between life and death

## Role of the hippocampus

- Seems to add spatial / contextual processing of an emotional stimulus
- Seems to binds separate components of memory into a unified whole

### If hippocampal functioning is impaired:

**fragmented and decontextualised memories can result**

## Effects of stress

### On the hippocampus:

- Impairs functioning
- Causes degeneration of hippocampal cells
- Adversely affects declarative memory

### On the amygdala:

- Enhances functioning
- Leads to overly-strong conditioned emotional responses

## Intense stress (trauma)

- \* may *impair* explicit memory of the trauma: (*amnesia*)
- \* **but:** may *amplify* implicit emotional memories formed during the event

### LeDoux:

Stress may cause us to react to danger, rather than think about it

## This may explain some aspects of anxiety disorders:

### There may be poor (or no) *conscious* memory of a traumatic experience

- the hippocampus was shut down or not functioning properly

## Anxiety disorders:

**But at the same time there may be very strong *unconscious (implicit)* memories**

- due to enhanced amygdala-mediated fear conditioning
- = *potentially very powerful unconscious sources of intense anxiety*

## Coming up...

- We will now take a short **break** ... 😊
- Later, we will look at some explanatory models which have been proposed for PTSD and OCD, and consider how these relate to the fear conditioning paradigm

## Explanatory Models: OCD Dinn, Harris, & Raynard (1999)

- OCD can develop as an adaptation to long-term fear or traumatic stress in childhood:

*this fear or stress generates a high level of anxiety during development*

- 3 causal factors

## Dinn, Harris, & Raynard (1999)

### 1. Traumatic stress in childhood (fear):

e.g. due to family psychological problems (psychiatric illness, suicide, alcoholism)

- causes *hypersensitivity* to cues signalling threat or danger

Result of a chronically insecure environment

Dinn, Harris, & Raynard (1999)

2. Impaired information processing (cognitive distortions):

- negative intrusive thoughts
- preoccupation with danger
- "magical" beliefs

Result of child trying to get control over the threatening situation

Dinn, Harris, & Raynard (1999)

3. Orbitofrontal dysfunction:

- enhanced responsiveness

Result of long-term threat in childhood

PTSD  
Metcalf & Jacobs (1996)

"Hot" memory system:

- ❖ amygdala-centred
- ❖ emotional processing

Critically involved in traumatic memory formation

"Cool" memory system:

- ❖ hippocampus-centred
- ❖ cognitive processing

Inactive during traumatic memory formation or deactivated by stress

PTSD  
Dual representation theory (Brewin, 1996; 2001)

Distinction between:

- \* hippocampal-based memory
- \* amygdala-based memory

The different effects of stress on these systems explains the *coexistence* of *flashbacks* and *amnesia*

(Brewin, 1996; 2001)

*verbally accessible memories (VAMs):*

- language-based
- result of conscious processing
- can be deliberately retrieved and verbally expressed
- conscious perception plus perceived meanings
- ordinary autobiographical memories
- hippocampus-based

*situationally accessible memories (SAMs):*

- perceptually- or image-based
- result of non-conscious processing
- cannot be deliberately accessed / verbally expressed
- can be automatically accessed in contexts similar to the traumatic situation (*flashbacks*)
- amygdala-based

(Brewin, 1996; 2001)

Trauma is followed by **conscious** emotional processing:

- attempt to integrate conflicting information from the trauma into pre-existing knowledge (i.e., to make sense of what happened)
- deliberate focus on content of flashback
  - repeated *conscious* processing of sensory and physiological details of the trauma aids cognitive readjustment

Activate SAMs in this processing:

- try to prevent *automatic* reactivation of SAMs
- create new SAMs to block old ones

## (Brewin, 1996; 2001)

### Successful trauma response:

- Detailed VAM representations are created and fully integrated with pre-existing knowledge
- Relative functioning of hippocampus and amygdala important:

#### Impaired hippocampal functioning:

- incomplete VAMs

#### SAMs:

- More perceptually vivid
- Spontaneously accessed

## Unsuccessful trauma response:

### Chronic emotional processing:

- Permanent preoccupation with trauma, but repetitive processing: few changes to existing representations
- Trauma reminders continue to activate memory representations and bring them into consciousness

### Prematurely inhibited processing:

- Avoid thinking about trauma
- No further active emotional processing
- **but** trauma-related SAMs still accessible in similar circumstances
- Unprocessed memories can be reactivated later (though person may seem to have recovered)

## PTSD

### Diamond, Park, Puls & Rose (2001)

#### 3-phase model

Emotional memories processed by sequential shifts in dominance between amygdala and hippocampal memory systems

### Diamond, Park, Puls & Rose (2001)

#### Phase 1: Stressful experience begins: change from neutral to heightened emotionality

- Hippocampal memory system suppressed:
  - Impaired access to existing information
- Amygdala system takes over

### Diamond, Park, Puls & Rose (2001)

#### Phase 2: Amygdala system dominant during stressful experience:

- attention narrowed: focus on central action
- very efficient processing of information which produces increased emotional response
- contextual details ignored

### Diamond, Park, Puls & Rose (2001)

#### Phase 3: Hippocampus slowly recovers: constructs "post hoc" representation of experience

(may be impaired for up to 2 days after traumatic event)

#### **BUT:** *Its only source of information is the representation stored in amygdala*

(this contains only isolated sensory fragments of experience)

PTSD  
Beck & Clark (1997)

**3-stage information-processing model:**

Both *automatic (non-conscious)* and *conscious processing*

Anxiety results from attentional bias towards personally threatening material in early (automatic) stages

Beck & Clark (1997)

**Stage 1: Automatic (non-conscious) processing:**

- Rapid automatic assessment: is stimulus threatening?
- If yes: Pay more attention to it

**Stage 2: Automatic *and* conscious processing**

- Initial threat appraisal
- Prepare coordinated strategy: minimize danger / maximise safety
- Activation of a "primal mode" :
  - cognitive & behavioural patterns related to basic survival
  - inflexible & rigid behaviour

Beck & Clark (1997)

**Stage 3: Conscious processing:**

- slow, elaborate, reflective information processing
- secondary threat appraisal:
  - coping resources evaluated
- event contextualised, fitted in with existing knowledge
  - person "makes sense of" what happened

*But:*

Can implicit memories really influence our behaviour?

**Implicit memories influence behaviour**

**Korsakoff (1889):**

Amnesic patient who had been given an electric shock did not remember the shock, but recognised the apparatus and its purpose

**Claparède (1911):**

Amnesic patient refused to shake hands with him, after earlier handshake in which he had pricked her hand with a hidden pin, but which she could not remember happening

**Implicit memories influence behaviour**

**Van der Kolk and Van der Hart (1989)**

- WW1 veterans experienced flashbacks to being in the trenches when on the New York subway
- A woman who had been in a nightclub fire reenacted the event each anniversary but could not consciously remember the fire

## Jacobs and Nadel (1985)

Experiences before age 3 cannot be *explicitly* remembered:

- Hippocampus not fully formed and functional until 18-36 months after birth in humans:
  - *explicit memories cannot be formed*

However: experiences may still be recalled *implicitly* and **affect behaviour**:

- Amygdala matures functionally before hippocampus
  - *unconscious memories can be formed*

## Terr (1991)

Proposes 4 characteristic features of conditions resulting from childhood trauma

- All are *behavioural* indications of the trauma, not *verbal* recall of it

## Terr (1991)

### 1. Vivid revisualisations / re-experiences:

- *Flashbacks, drawing or playing out scenes from the trauma*

Even infants and toddlers at the time of the experience do this:

*despite being unable to form, store, or retrieve full verbal memories of the trauma*

## Terr (1991)

### 2. Repetitive behaviours

- *Behavioural & physiological reenactments*
- *Repetitive post-traumatic play which repeats aspects of the event*

**The child is usually completely unaware that their behaviour is repeating the trauma**

Even children exposed to trauma before 12 months do this

*i.e., children with no verbal memory of the trauma*

## Terr (1991)

### 3. Trauma-related fears

- of the dark, of being alone, of strangers
- of specific things related to the event

### 4. Sense of a limited future

- pessimism

## Pillemer (1998)

Children may be unable to express their memories *verbally*; but may still show other forms of memory

Clear and consistent evidence exists that childhood traumatic experiences can influence later behaviour

### Pillemer (1998)

#### 18-20 month infants:

Can imitate a specific novel activity after observing it briefly a few months before:

touching box with forehead to make it light up

#### 2½ year old children:

Can remember a single experience with a psychology task both behaviourally and emotionally:

children repeated a task more accurately, were less disturbed than controls by doing experiment in dark

### LeDoux (1996)

**Implicitly processed stimuli may activate amygdala without this being represented in consciousness:**

*e.g., person traumatised in a car accident in which the car horn got stuck*

### LeDoux (1996)

- **Details of accident eventually forgotten by explicit memory system**
  - so ignores sound of a horn years later
- **But may be retained in implicit memory system**
  - so sound of horn activates amygdala and reactivates original emotional reaction to it

*Thus:* person experiences emotional arousal **but does not know why**

### Pierre Janet (1894; 1898; 1907)

- Proposed a connection between childhood trauma and psychiatric illness
- Importance of childhood stressors not always obvious from psychological symptoms or maladaptive behaviours
- Reactions to stress may include excessive and stereotyped images, ideas, emotions and movements more relevant to past threats than to the current situation

### Janet (1894; 1898; 1907)

Recognised importance of past events and their accompanying emotional reaction for psychopathology:

The **intensity** of the *initial* emotional reaction to the traumatic event can lead to subsequent symptoms of psychopathology, **not** necessarily the event itself

*Thus:* even ordinary stressors could have effect  
- *e.g. financial or marital problems*

### Janet (1894; 1898; 1907)

- **There may be a long time between a traumatic event and its psychopathological expression**
  - person may forget original intense emotional experience: this prevents formation of narrative memory
- **YET they may remain troubled by it:**
  - memory traces may linger as subconscious fixed ideas, which cannot be translated into a personal narrative
- **This prevents integration of events:**
  - Instead they become intrusive terrifying perceptions, obsessional preoccupations, somatic re-experiences such as anxiety reactions

## Structural effects of childhood trauma

Early childhood trauma can permanently change structures in the brain

- use-dependent modifications caused by prolonged stress response

( = adaptation to continuing danger or stress)

## Structural effects

If stress response is frequently and persistently active during development (as a reaction to threat):

- it becomes *over-active & hypersensitive*

**Result: dysfunctional & maladaptive functioning of amygdala / hippocampus**

- this alters emotional, cognitive, behavioral, and physiological functions

## Structural effects

This is adaptive for a child developing in a threatening environment, constantly in a low-level state of fear

**BUT:** it can create problems in later life

The changes are permanent:

**SO:** *the effects of the trauma remain with the person for the rest of their life*

## Conclusion

The work of LeDoux seems to offer insights which could form the basis of more effective responses to traumatic experiences