

ECPS6005: COGNITION IN ACTION

COGNITION AND CLINICAL APPLICATION

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DECISION-MAKING IN CLINICAL SETTINGS

- Humans are generally inconsistent with detection.
- In lab, Ps asked to detect sound of varying volume, light of varying intensity, or object recognition.
 - Signal is pre-determined and researcher controls number of trial presentations.
- In real-world, there is vast variation.

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DETAILED EXAMPLE



- **Medical Diagnosis:**
- Main application: Detect disease (present/absent)
- Considerations:
 - Strength of signal
 - Sensitivity of decision maker
 - Salience of disease
 - Number of other 'related' symptoms
 - Experience of decision maker

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MEDICAL DIAGNOSIS

- **Example:**
 - Detecting cancerous tumour vs. benign cyst.
- **Implications:**
 1. Not detecting cancerous tumour
 2. Inaccurately detect benign cyst as cancerous tumour.

High stakes combined with time pressure, generates stress for decision-maker.

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MEDICAL DIAGNOSIS SDT MATRIX

		Radiologist's response	
		"Yes"	"No"
Cancerous tumour	Present	Hit	Miss
	Absent	False alarm	Correct rejection

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SDT: MEDICAL DIAGNOSIS



- Aim: improve radiologists' sensitivity
- Use checklist listing features to be considered
- Assess confidence
- Less experienced radiologists = greater sensitivity using checklist compared to not.

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SDT: MEDICAL DIAGNOSIS

- For every 100 patients with cancer, checklist increased detection in ~ 13 additional patients
- For patients without cancer, it decreased unnecessary need for biopsies in ~12 patients.
- Other factors influencing decision: Timepoint when patient is examined
 - Initial screening (high beta, low probability)
 - or at referral (lower beta, higher probability). (Parasuraman, 1985)



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SDT: MEDICAL DIAGNOSIS

- What about payoffs (value/cost) in medical decisions?
 - How can consequence of Hits, FAs, and misses be quantified when human lives involved?
 - Although uncomfortable to think about, they have key influence on detection rate.
 - But instead of considering all outcomes individually, criterion limit can be set.
 - Swets (1998): FA rate is ~.10 in medical contexts.



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SDT: MEDICAL DIAGNOSIS

- However, there are differences in criterion setting between different countries
- E.g., in US, probability of signal given a “yes” response is 20-30%, whereas in England it is ~50%.
 - Consequence of difference between US & UK healthcare influences this?

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INFLUENCES ON DECISIONMAKING



EXTERNAL PRESSURE AND INTERNAL
COGNITIVE PROCESSING IMPACTS DECISIONS.

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INFLUENCES ON DECISION MAKING



- Simulation Heuristic
 - Judgment based on ease a plausible scenario can be constructed
- Like availability heuristic
 - But ease of imagination instead of direct retrieval from memory

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INTERACTIVE TASK – THE UNDOING PROBLEM

Two different travellers are heading to the airport.
They are catching different flights, which leave at same time.
They meet outside a hotel and decide to share a taxi.
On the way, they get caught in a traffic jam and get to the airport 30 minutes late.
They both expect to have missed their flight.



However, when they arrive, traveller A is told their plane left on time and traveller B is told their plane was delayed but left 5 minutes ago.

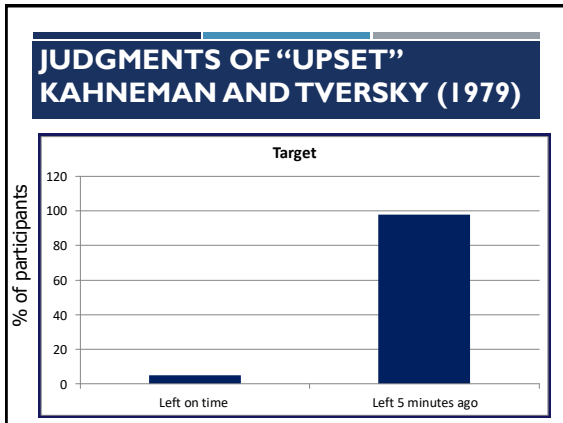
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INFLUENCES ON DECISION MAKING



Who is more upset?
Person A or B?

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INTERACTIVE TASK: THE UNITED NATIONS QUERY

- Estimate the % of countries in the United Nations that are from the continent of Africa
 - Some people say 10%
 - What do you say?
 - Some people say 65%
 - What do you say?

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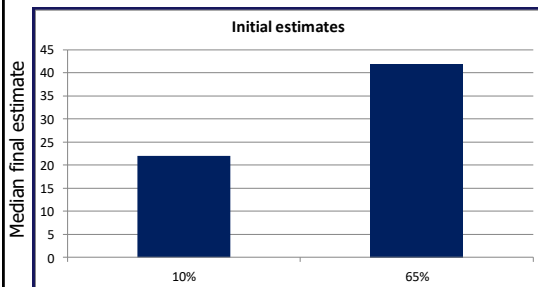
THE ANCHORING AND (INSUFFICIENT) ADJUSTMENT HEURISTIC

When we make estimates, we are influenced by initial value state

- Tversky and Kahneman (1974)
- see also Epley and Gilovich (2006)

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AFRICAN COUNTRIES IN UN KAHNEMAN AND TVERSKY (1974)



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ANCHORING AND ADJUSTMENT HEURISTIC

- Final estimates overwhelmingly influenced by initial estimates
 - Estimates begin with initial values
 - Initial value serves as anchor
 - Common sales technique
- Estimates can even be influenced by meaningless or unrelated figures

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BOUNDED RATIONALITY

- Herb Simon (1960, 1978)
 - Humans exhibit 'bounded rationality'
 - We make rational decisions within the limits of human information processing
 - E.g. STM capacity, incomplete knowledge, uncertainty
 - Definition of situation likely incomplete
 - Impossible to generate all alternatives
 - Impossible to predict consequences of each alternative

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SDT: VIGILANCE

Mackworth (1948/1950):

- Experienced vs. trainee radar operators.
 - “Clock Test”: Detect double-jump of pointer.
 - Decline in efficiency after 30 mins.
 - “*Breakdown of Vigilance*”
 - “*Vigilance Decrement*”



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TIME-BASED DECISION MAKING

- Let's try a quick experiment:
 - Close your eyes and count to 20 in your head
 - When you get to 20 open your eyes and put your hand up.
- How good are we at estimating time intervals?

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THEORIES OF VIGILANCE PERFORMANCE

- **Inhibition theory:**

- Vigilance decrement is like extinction of conditioned response when response is no longer reinforced (Mackworth, 1950).

- **Arousal theory:**

- Vigilance decrement occurs due to decline in CNS arousal

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THEORIES OF VIGILANCE PERFORMANCE

- Mackworth (1950): decrement in vigilance can be reduced (better vigilance) by giving people amphetamine
- Could be increased (worse vigilance) when sleep deprived



VS.



ETHICS!!!

- But empirical work suggests arousal may only influence perceptual sensitivity not response criterion.

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THEORIES OF VIGILANCE PERFORMANCE

- **Habituation theory:**

- Reduction in neural responses following repeated presentation of same stimulus (Mackworth, 1968).

- **Filter theory:**

- Attending to same info for long time leads to interruption that increase due to mechanism that selects information from environment (filter), is biased towards selecting novel information (Broadbent, 1958).

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THEORIES OF VIGILANCE PERFORMANCE

• Resource theory:

- Workload is main factor
 - Prolonged performance on task depletes pool of resources.
 - More demanding a task, more resources required.
 - Workload-dependent decrements.
 - Generalised decrement seen across qualitatively different tasks.

• Sustained-demand theory:

- Vigilance tasks place major demands on information-processing resources, leading to increase arousal/stress (Warm, et al., 2008).

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THEORIES OF VIGILANCE PERFORMANCE

• Expectancy theory:

- Observers track past signals to predict future ones.
- If signals are presented regularly or there is knowledge about accuracy of signal, then expectancies will be more accurate and detection efficiency will improve.
- Essentially, many theories with strengths and weaknesses.
- But important consideration is how different elements could influence vigilance and decision-making of clinicians.

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COGNITION AND CLINICAL POPULATIONS

- Patients differ: cognitively, behaviourally, physiologically, and perhaps biochemically from healthy individuals.
- Understanding symptoms and role played by cognitive factors crucial for treatment.
- Theorists (e.g., Beck & Dozois, 2011) assume clinical anxiety and depression depend on cognitive biases.



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COGNITIVE BIASES

- Attentional bias (AB)
- Interpretive bias (IB)
- Explicit and Implicit memory bias (MB)
- Key question: do cognitive biases play role in triggering disorder; or does disorder enhance the cognitive bias?
- Various tasks used to assess AB.....



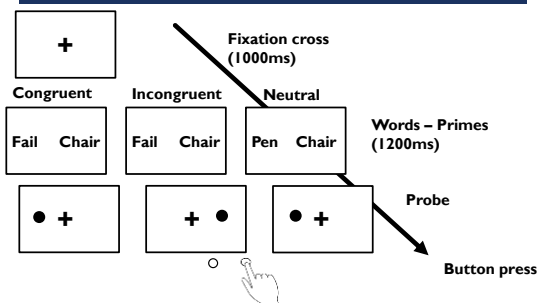
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DOT-PROBE TASK

- Allocation of attention assessed by recording speed of detecting and responding to dot that replaces stimulus.
- Detection latencies shorter in attended areas
- AB shown through detection latencies being shorter when dot replaces negative stimulus.

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DOT-PROBE TASK



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EMOTIONAL STROOP

- Traditional Stroop task (Stroop, 1935): assessing competition between colour word and colour of ink.

Green
 Black
 Red
 Purple
 Orange
 Blue

VS

Green
 Black
 Red
 Purple
 Orange
 Blue

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EMOTIONAL STROOP

- Emotional Stroop task, same as traditional in naming colour of the ink.

- However, words will either be negative or neutral.

SAD	SKY
HATE	TABLE
DEPRESSED	CAR
CRYING	PEN
ANXIOUS	FOOD

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EMOTIONAL STROOP

- People with anxiety take longer to name colour of emotionally negative words compared to neutral words.

- Thus, showing attentional bias effect.

SAD	SKY
HATE	TABLE
DEPRESSED	CAR
CRYING	PEN
ANXIOUS	FOOD

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EVALUATION

- Dot-probe and Emotional Stroop only provide RT data
 - Difficult to know if anxiety/depression affects attentional engagement or disengagement (Clarke et al., 2013).
- Eye-tracking can help
- Armstrong and Olatunji (2012): meta-analysis on studies measuring eye movements during visual search task
 - Anxious Ps = increase vigilance for threat and found it harder to disengage from threat compared to controls.
 - But less evidence of this in depressed Ps – instead, they took longer to engage with and spent less time looking at positive stimuli.



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MEMORY BIASES

- May play role in maintaining negative mood
- Can occur via automatic process: **Implicit** memory bias
 - Superior performance for negative/threat than neutral or positive information on memory tests **not** involving conscious recollection.
- Or process the individual is aware: **Explicit** memory bias
 - Tendency to retrieve negative/unpleasant rather than positive or neutral information on memory tests involving conscious recollection.

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RESEARCH EVIDENCE

- Williams et al. (1997): Explicit memory bias found in depressed patients compared to anxious patients
 - Whereas opposite was case for implicit bias.
- However, Mitte (2008) did not find evidence of anxiety associated with implicit bias
 - Goes directly against work of Williams et al.

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POSSIBLE EXPLANATION?

- Type of memory test used.
 - Anxiety associated with memory biases in **recall** but **not recognition**
- Extensive retrieval processes required for recall
 - Provides more scope for involvement of emotion.
- Depression (more than anxiety) associated with inward focus and disengagement from environment.
- Depression (more than anxiety) associated with negative past events (Eysenck et al., 2006).

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INTERACTIVE TASK

- Work in small groups (10-15 minutes)
- Pick a Cognitive Bias from the following website: <https://yourbias.is/>
- Consider how this bias might influence:
 1. A clinician's decision about a patient
 2. A clinical patient's thought processes

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COGNITIVE VULNERABILITY HYPOTHESIS

- Cognitive therapists (e.g., Williams et al., 1997; Beck & Dozois, 2011) suggest healthy individuals possessing cognitive biases more vulnerable to anxiety or depression.
- Negative life event should have greater adverse effects on well-being of individuals with cognitive biases.
 - See Lewinsohn et al. (2001) and Cohen et al. (2012)

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COGNITIVE BIAS MODIFICATION

Key Question

- Do cognitive biases make individuals more vulnerable to anxiety/depression?
- Or does anxiety/depression lead to development of cognitive biases?
- Can address this through cognitive bias modification

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COGNITIVE BIAS MODIFICATION

- Experimental paradigm that uses training to induce maladaptive or adaptive cognitive biases.
 - E.g., altered version of dot-probe task where dot always appears in location where neutral stimulus was presented.
 - Patients learn to avoid allocating attention to threatening stimuli.
- Good success rates and training to reduce one type of CB often leads to reduction in another type of CB.

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COGNITIVE BIAS MODIFICATION

■ Evaluation:

- + Is focused, so easy to understand underlying mechanisms
- + Enhanced understanding of relationship between bias and emotional states.

(MacLeod & Clarke, 2013)
- Little generalisation/transfer from lab to real life
- Assessment of changes in anxiety/depression often involves self-report measures
- Patients often report being unclear on reasons behind cognitive bias modification

(MacLeod & Mathews, 2012)

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COGNITION IN CLINICAL APPLICATION

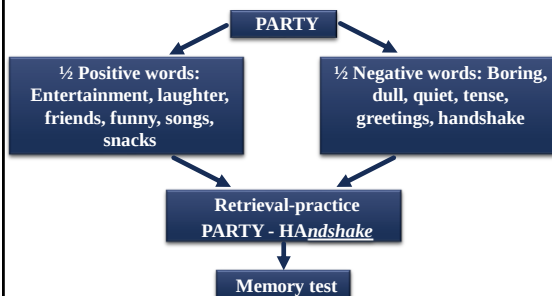
RIF in Generalised Social phobia disorder: Amir et al. (2001)

- Intrusive memories of negative social interactions.
- Constant retrieval of negative social information prevents socially phobic individuals from forgetting socially negative memories.
- Negative social information highly integrated in memory.
- All negative social situations tightly bound together.
- Difficult to forget negative information because retrieval of one cue ends up retrieving others.

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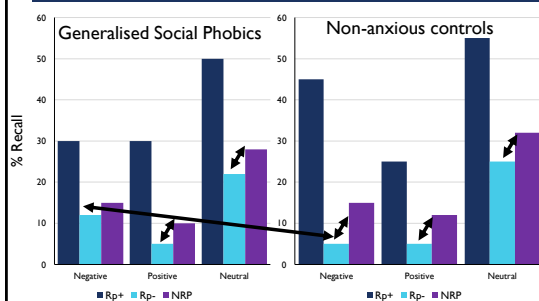
AMIR ET AL. (2001)

- Two groups: Generalised social phobics and non-anxious controls
- Given 4 neutral and 4 social categories of words – in social category, words were divided into positive and negative.



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AMIR ET AL. (2001)



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COGNITION IN CLINICAL APPLICATION

- Unconscious forgetting in emotional memory:
- Barnier et al. (2004)

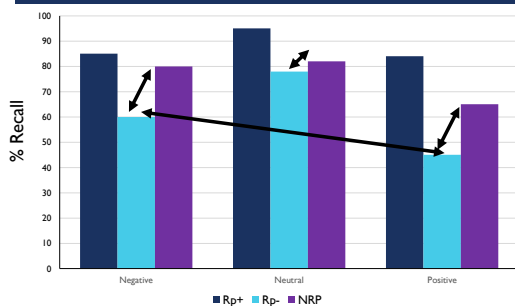
Negative: horrified, sickness, tragedy
Neutral: hardworking, patient, polite
Positive: entertaining, excitement, happy

Retrieval Practice

Recall

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BARNIER ET AL. (2004)



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INTERACTIVE DISCUSSION TASK

COGNITIVE BIASES IN CLINICAL MEDICINE PAPER ON MOODLE:

O'SULLIVAN & SCHOFIELD (2018)

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