

COGNITION IN ACTION

LECTURE SEVEN: COGNITION AND CLINICAL APPLICATION

Dr Kate Williams

1

DECISION-MAKING

- Detection in real-world is important.
 - Individual level – e.g., moving out of way of objects
 - Broader level – e.g., in industrial settings.
- But humans are inconsistent with detection.
- In lab research, participants detect sound of varying volume, light varying in intensity, or object recognition.
- However, in lab studies, signal is pre-determined with control of number presented during a trial.
 - In real-world, there is vast variation.

2

AN EXAMPLE IN DETAIL

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

3

MEDICAL DIAGNOSIS

- Example:
 - Detecting cancerous tumour vs. benign cyst.
- Implications:
 - Not detecting cancerous tumour or
 - Inaccurately detecting benign cyst as cancerous tumour.

4

MEDICAL DIAGNOSIS SDT MATRIX

		Radiologists response	
		"Yes"	"No"
Cancerous tumour	Present	Hit	Miss
	Absent	False alarm	Correct rejection

5

SDT: MEDICAL DIAGNOSIS (SWETS, 1998)

- Aim: improve radiologists' sensitivity in discriminating cancerous tumours from benign cysts.
- Use checklist listing features to be considered.
- Assess confidence.
- Less experienced radiologists show greater sensitivity when using checklist compared to not using the checklist.

6

SDT: MEDICAL DIAGNOSIS (SWETS, 1998)

- 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: Point when patient is examined
 - Initial screening (high beta, low probability)
 - or at referral (lower beta, higher probability). (Parasuraman, 1985)

7

SDT: MEDICAL DIAGNOSIS

- What about payoffs (values and costs) in medical decisions?
 - How can consequences of Hits, FAs, and misses be quantified in decisions when human lives are involved?
 - Although uncomfortable to think about, they have important influence on detection rate.
 - However, instead of considering all four outcomes individually, a criterion limit can be set.
 - Swets (1998) suggests the FA rate is ~.10 in medical contexts.

8

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

9

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”*



10

SDT: VIGILANCE

- Theories of vigilance concerned with explaining vigilance decrement
- But overall detection efficiency is low regardless of whether performance deteriorates over time.
- In SDT, vigilance decrement is either due to decrease in sensitivity or shift to more conservative criterion.
 - This will depend on the task, context, and situation.

11

MEASURING VIGILANCE PERFORMANCE

- What influences sensitivity in vigilance performance?
 - Signal strength (change intensity or duration of target)
 - Uncertainty (change time or location of target)
 - Event rate (change number of times target appears)
 - Task type (simultaneous vs. successive)
- What influences bias in vigilance performance?
 - Target probability:
 - High = more hits and FAs (low beta)
 - Low = more CR and misses (high beta)
 - Payoffs (but less consistent & less effective than probability)

12

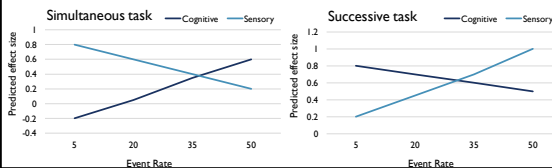
MEASURING VIGILANCE PERFORMANCE

- Meta-analysis: 42 vigilance studies, 138 different conditions.
- Sensitivity decrement found in most with large magnitude.
- Larger effect sizes for high event rate tasks and tasks requiring a succession of discriminations.
- Also: task difficulty influenced sensitivity decrement independently of other factors –
 - More difficult the task = greater sensitivity decrement

13

MEASURING VIGILANCE PERFORMANCE

- However, effects of **event rate** and **information processing** requirements interacted with each other differently depending on whether vigilance **task was sensory or cognitive**. (See et al., 1995).



14

THEORIES OF VIGILANCE PERFORMANCE

- **Inhibition theory:**
 - Vigilance decrement is similar to extinction of conditioned response when that response is no longer reinforced (Mackworth, 1950).
- **Arousal theory:**
 - Vigilance decrement occurs due to decline in CNS arousal

15

THEORIES OF VIGILANCE PERFORMANCE

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



VS.



ETHICS!!!

- But empirical work suggests arousal may only have an effect on perceptual sensitivity and not response criterion.

16

THEORIES OF VIGILANCE PERFORMANCE

- **Habituation theory:**
 - Reduction in neural responses following repeated presentation of the 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).

17

THEORIES OF VIGILANCE PERFORMANCE

- **Resource theory:**
 - Workload is main factor
 - Prolonged performance on task may deplete pool of resources as person becomes fatigued.
 - More demanding a task, more resources are required.
 - Known as workload-dependent decrements.
 - Theory supported by a generalised decrement being 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).

18

THEORIES OF VIGILANCE PERFORMANCE

- **Expectancy theory:**
 - Observers track past signals to predict future ones.
 - If signals are presented regularly or there is knowledge given 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.

19

COGNITION IN PSYCHOLOGICAL CLINICAL POPULATIONS



20

COGNITION AND CLINICAL POPULATIONS

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

21

COGNITIVE BIASES

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



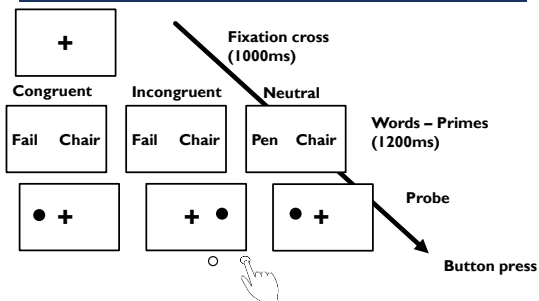
22

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.

23

DOT-PROBE TASK



24

EMOTIONAL STROOP

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

Green	VS	Green
Black		Black
Red		Red
Purple		Purple
Orange		Orange
Blue		Blue

25

EMOTIONAL STROOP

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

- However, words will either be negative or neutral.

SAD HATE DEPRESSED CRYING ANXIOUS	SKY TABLE CAR PEN FOOD
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26

EMOTIONAL STROOP

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

- Thus, showing attentional bias effect.

SAD HATE DEPRESSED CRYING ANXIOUS	SKY TABLE CAR PEN FOOD
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27

RESEARCH EVIDENCE: ANXIETY & DEPRESSION

- Bar-Haim et al. (2007): Meta-analysis on studies involving subliminal and supraliminal presentation of stimuli.
 - Strong evidence of AB across all types of anxiety disorders and in high-trait anxious healthy individuals.
- Cisler and Koster (2010): AB depends on an automatic threat-detection mechanism.
 - Anxiety produces difficulty in disengaging attention from threat stimuli due to poor attentional control.

28

RESEARCH EVIDENCE: ANXIETY & DEPRESSION

- Peckham et al. (2010): Meta-analysis on studies involving patients with diagnosed depression.
 - Clear evidence for AB with dot-probe task
 - Marginal evidence for AB with Emotional Stroop task
- **Why is there a difference?**



29

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 depressed Ps took longer to engage with and spent less time looking at positive stimuli.



30

MEMORY BIASES

- Useful to understand as it could help treat patients
- 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.

31

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.

32

POSSIBLE EXPLANATION?

- Depends on type of memory test used.
 - Anxiety associated with memory biases in recall but not recognition
- Because extensive retrieval processes required for recall
 - Provides more scope for involvement of emotion.
- Effects of anxiety and depression on memory differ
 - Implicit and explicit memory bias in depressed but not anxious patients.
- Depression (more than anxiety) associated with inward focus and disengagement from the environment.
- Evidence suggests depression (more than anxiety) is more associated with negative past events (Eysenck et al., 2006).

33

COGNITIVE VULNERABILITY HYPOTHESIS

- Cognitive therapists (e.g., Williams et al., 1997; Beck & Dozois, 2011) suggest healthy individuals possessing various cognitive biases are more vulnerable than others to develop 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)

34

CONCLUSIONS

1. Anxious and depressed individuals differ in nature and strength of cognitive biases.
 - Contributes to understanding differences between these disorders
2. Findings have theoretical importance:
 - Function of anxiety is to anticipate future threat
 - As result it is associated with external focus and attentional bias
 - Function of depression is thinking of past failure for future goals
 - As result it is associated with internal focus and memory biases.

35

CONCLUSIONS

3. Existence of cognitive biases in anxiety and depression is of value to therapeutic interventions.
 - Suggests therapy focus be on reducing/eliminate cognitive biases
 - Progress of therapy can be assessed by extent CBs are reduced.
4. Progress in understanding interconnections among cognitive biases.
 - However, underlying mechanisms remain to be identified.

36

COGNITIVE BIAS MODIFICATION

Key Question

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

37

COGNITIVE BIAS MODIFICATION

- An experimental paradigm that uses training to induce maladaptive or adaptive cognitive biases.
 - E.g., an altered version of the dot-probe task where the dot always appears in the location where a neutral stimulus had been presented.
 - As a result patients learn to avoid allocating attention to threatening stimuli.
- Generally have good success rates and training to reduce one type of cognitive bias often leads to reduction in another type of cognitive bias.

38

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)

39

COGNITION IN CLINICAL APPLICATION

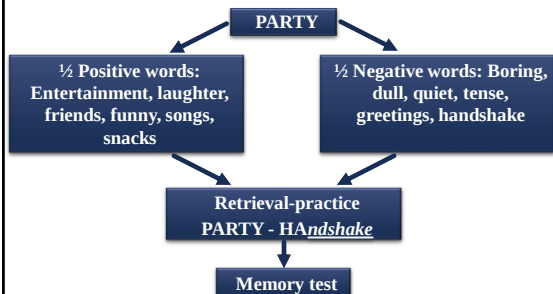
RIF in Generalised Social phobia disorder: Amir et al. (2001)

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

40

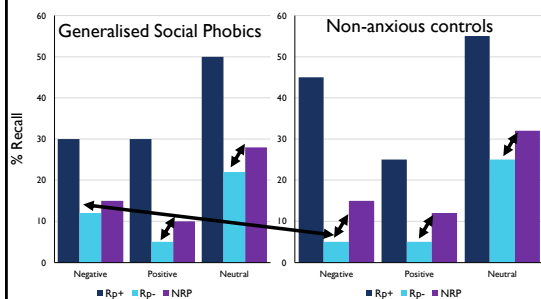
AMIR ET AL. (2001)

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



41

AMIR ET AL. (2001)



42

COGNITION IN CLINICAL APPLICATION

- Unconscious forgetting in emotional memory:

- **Barnier et al. (2004)**

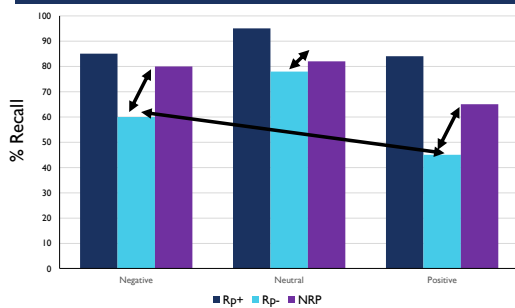
Negative: horrified, sickness, tragedy
Neutral: hardworking, patient, polite
Positive: entertaining, excitement, happy

Retrieval Practice

Recall

43

BARNIER ET AL. (2004)



44
