The cross-task cue utilisation and diagnostic performance of radiologists

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Background

- Diagnostic error is problematic in radiology: discovered through subsequent tests/clinical findings
- Accounts for ~ 30% of missed cancers (Grabor, 2005)
- Need to understand the underlying cognitive mechanisms
What do we know about expertise?

- A large amount of visual information is processed in less than a second; experts can rapidly detect and localise abnormalities (Carrigan, Wardle & Rich, 2018)

- Fine tuned visual perception and cognitive skills (Nodine & Krupinski, 1998)

- A superior ability to encode large scale visual patterns (Drew, et al., 2013)

- Based on a mental representation of a set of features, or a global pattern

Scanning patterns

Trainee
Scan → Look → Detect

Expert
Look → Detect → Scan

(Kundel & La Follette, 1972)
Explicit patterns in radiology

Spoke Wheel pattern
= Focal nodular hyperplasia

Microcalcifications
Irregular borders
Spiculation
= Suspicious breast mass

Implicit pattern recognition and cues

- Patterns of activation depends on a signal extracted from the environment (e.g., local feature)
- Activates a previously acquired feature-object/event associations in memory that serve as ‘cues’

(Wiggins, 2014;2015)
Individual differences in cue utilisation

• Activation and retrieval of cues from long-term memory = relatively fewer demands on working memory resources
  (Brouwers, et al., 2017; Sturman et al., 2019)

• Behaviour that reflects differences in cue utilisation corresponds to differences in diagnostic performance
  (Loveday, et al., 2013)

• Behaviour reflecting higher cue utilisation is associated with greater recognition of implicit patterns
  (Loveday & Wiggins, 2014)

Research Questions

1. Does cue utilisation predict performance on a diagnostic task?

2. What is the joint contribution of experience and cue utilisation to diagnostic accuracy?
Methods

Participants: N = 59
Registrars = 18; Qualified radiologists = 41
Years of Experience: M = 14 (SD = 12, range 1-41)
Cases per year: 0 – 25000

Measures: 30 minutes
1. Radiology edition of the established cue utilisation assessment tool EXPERTise 2.0
2. Image interpretation task - included as an independent measure of diagnostic performance

Data Collection

Canberra: RANZCR
Chicago: RSNA
1. **EXPERTise 2.0**
(Wiggins, Loveday, Auton, 2015)

- Infers a level of cue utilisation based on patterns of behavior
- 5 tasks that measure different aspects of the construct cue utilisation

**EXPERTise 2.0: How Does it Work?**

Good diagnosticians can…

![Diagram of Cue Utilisation]

- Identify
- Recognise
- Prioritise
- Discriminate
- Compare
1. Feature Identification Task

Measure = Response latency

Higher CU = faster

2. Feature Recognition Task

4000 ms presentation
Measure = accuracy
Higher CU = higher accuracy
3. Feature Association Task

MRI

Gadolinium

Expertise in Radiology_EXP_DV

Feature Association Task

How related are the terms?

1 2 3 4 5 6

Extremely Unrelated Extremely Related

Measures = rating variance, response latency variance
Higher CU = greater variance and faster
4. Feature Discrimination Task

Expertise in Radiology_EXP_DIV

Feature Discrimination Task

It is 11:30am on Thursday April 2nd and you are reporting cases from the emergency department. Your next case is a plain chest radiograph and the request form reads 'Persistent cough'. The patient had been visiting the zoo when she began coughing and arrived to the ER via an ambulance. You load the case on PACS and note that the patient is a 4 week old girl visiting with her 18 year old parents, who live on a poultry farm in New Zealand. The AP supine chest can be seen below:

![X-ray Image]

4. Feature Discrimination Task

Measure = Variance

Higher CU = greater variance across feature-relevance ratings
5. Feature Prioritisation Task

Feature Prioritisation Task

You have been called by the on-call sonographer to review a case from the emergency department. As quickly as possible, access the information below that you feel is necessary to decide on your response.

You have 27 seconds remaining to make your decision
Click on the tabs below to access the relevant information

- Time of Day
- Date of Presentation at ED
- Sonographer’s Experience
- Patient Symptoms
  - Vaginal Bleeding and pain
- Date of last Menstrual period
- Blood results
- Transabdominal - transverse view
- Transabdominal - sagittal

Measure = Ratio of sequential to non-sequential menus accessed

Higher CU = non sequential

Image Interpretation Task (39 items)

This is an Abdominal X-Ray of:

a) Small bowel obstruction
b) Gastroenteritis
c) Post-op ileus
d) Pancreatitis
e) None of the above

Answer = ‘a’

Measure = % correct
Results

RQ1

1. Does cue utilisation predict performance on a diagnostic task?

• EXPERTise 2.0 delineated two groups: Higher (n = 23) and lower cue utilisation (n = 28)

• Image interpretation task mean accuracy = 53% (SD = 9%)

ANOVA

• Those with higher cue utilization were more accurate on the diagnostic task (p = .004)

Results
Results
RQ2

What is the joint contribution of experience and cue utilisation to diagnostic accuracy?

ANCOVA
• Controlling for years of experience, effect remains ($p = .01$)
• CU has an effect on diagnostic performance over and above experience

Conclusions

• Important implications for the development of radiological skills
• Suggests that exposure sufficient to facilitate the acquisition and utilisation of cues is likely to yield the highest levels of performance
Application

Task-related experience, including training, needs to be structured to ensure that learners have the opportunity to acquire feature-event relationships and internalise these associations in the form of cues in memory.

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References


Questions

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