Using advances in Cognitive Psychology to enhance learning

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Today’s talk

1. Using ‘situation awareness’ principles to enhance learning in teams
2. Using ‘episodic memory’ principles to enhance learning from simulation

Team situation awareness during the ICU morning round

Intensive Care Medicine
• ICU teams provide life saving care to critically ill patients
• The complex, stressful, dynamic and team-centric nature of ICU care heightens likelihood of medical error

Teamwork and error in the ICU
• 5-10% of ICU admissions experience an adverse event
• Half of incidents caused by “failures in non-technical skills”

Situation awareness model (Endsley, 1995)

Analysis of 2677 critical incidents captured within 11 ICU error studies

• Perceive information in your immediate environment….
• Comprehend it….
• Think ahead….
• Make a decision….
• Act….
- Goals & Objectives
- Preconceptions (Expectations)
- System Capability
- Interface Design
- Stress & Workload
- Complexity
- Automation

**Projection of Future Status**

- Long Term Memory Stores
- Automaticity

**Information Processing Mechanisms**

- Abilities
- Experience
- Training

**TASK/SYSTEM FACTORS**

- Informational Influences
- Environmental Influences
- Personal Influences
- Organizational Influences

**E.g. Situation awareness in aviation**

- Aircraft status
- Flight centre
- E.g. Spatial Orientation
- E.g. Information held by crew members

**CREW SA & DECISION MAKING**

- E.g. Weather
- E.g. Air traffic control
- E.g. Other flights
- E.g. Information sharing
- E.g. Culture
- E.g. Decision-making

**SA and decision-making**

- 1. Ability to project ahead indicates expertise
- 2. Novices expand considerable mental energy on attention and comprehension for decision-making
- 3. Experts have pre-existing mental models (knowledge structures) within which to interpret new data
- 4. Expert decision-makers 'pattern match': recognising and acting on past experience
- 5. Things go wrong when we misinterpret a situation (i.e. we pattern match incorrectly)

**Research questions investigated:**

i. To what do intensive care teams form shared situation awareness during ICU morning rounds?
ii. Does participative decision-making influence the formation of team situation awareness

**Investigating team situation awareness in the Intensive Care Unit**

- Real-time data collection of team member situation awareness during the ICU round
- Focussed on team member 'anticipations for patient' outcomes (measured by team members using PDAs)
- Observed interactions during the patient round
- Self-report data on teamwork collected
- Patient outcome data collected
Sample

- 44 ICU team members (forming 37 unique teams)
  - 7 consultants
  - 5 senior registrars
  - 23 junior registrars
  - 9 senior nurses

Study conducted over a 3 months
Only patients admitted within 48hrs
105 patients

Results: Anticipating patient deterioration:
Team members formed conflicting anticipations (i.e. unshared SA) for 55% of patients

For items on patient discharge, patient survival, and withdrawal of ventilation the team had shared situation awareness for 65% of patients


Accuracy in predicting patient change

<table>
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<tr>
<th>Situation awareness item</th>
<th>Percentage of patients for whom the team formed shared anticipations</th>
<th>Percentage of anticipations accurate for predicting patient outcomes (by team member)</th>
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</table>
| Deterioration beforehand | 64                                                             | Senior doctor: 34%
| Normalization beforehand | 64                                                             | Senior doctor: 65%
| Senior nurse           | 65                                                             | Junior trainee: 95%

R = .19; P < .001

R = .07; P < .05

Conclusion 1.

- Team members frequently form divergent cognitions for patient status
- This occurs for more subtle aspects of a patient’s condition
- Qualitatively divergent anticipations of patient change (i.e. deteriorating/improving) indicates team members to have a different understanding of a patient’s condition/treatment to the rest of the team
- Junior trainee doctors are most likely to diverge
- Consultants most accurate in predictions
- Implications for safety and learning?

Involvement in the morning round decision making process

Teamwork and shared SA for anticipating patient change during the round
Earlier research shows team members to have different ‘norms’ on communication behaviour

Senior doctors
Nursing staff
Trainee doctors

Strongly agree that senior doctors and nursing staff communicate openly during patient D-M

Strongly agree that senior and trainee doctors communicate openly during D-M


Conclusion 2.

- Junior trainee doctors are more likely to form shared SA with consultants when they are involved in decision-making during the round
- This is presumably due to the round being used as a teaching event
  - Trainees can ask questions and investigate patient decision-making
- Considering the crudeness of the measures, this might also be true for other team members
- Self-perceived involvement in the round is closely linked to role hierarchies
- Implications for safety and learning?

Using episodic memory principles to enhance learning in simulation

Endel Tulving

Simulation

- Increasingly being used to aid training
- Experiential form of learning, whereby trainees ‘experience’ and learn from an event
- Safe learning space
- Different from ‘rote learning’ or ‘case learning’
- Fidelity can be low or high, but belief in the scenario appears important

Effectiveness of simulator training is not consistent.

Often successful, e.g.:
- Boet and colleagues (2011) found anaesthetists to retain cricothyroidotomy skills up to 1 year after simulation
- ACLS training can result in improved performance over time (Morgan et al., 2005)
- Simulator training can improve real-life performance of cardiopulmonary bypass (Bruppacher et al., 2010)
- But
- Simulator training can result in no improvement in the performance of oesophageal intubation (Olympio et al., 2003)
- Participants of simulator training often hit a ‘ceiling’ whereby further training sessions (after the first) do not improve skills for crisis management (Yee et al., 2005)
How can cognitive psychology help us to utilise simulator based-training?

1. We encode and recall ‘episodes’ holistically (e.g. knowledge, physical skills, and the place they were learned).
2. Episodic memories are triggered automatically (e.g. an environment cue) or through conscious search (recall).
3. An event need only be experienced once to be remembered: but we have little control over forming memories (the event is key).

**Simulation and episodic memory**

*Simulators try to aid learning through developing and utilising episodic memories (where skills, knowledge, and situational cues are tied together)*

*But the deployment of skills learnt in training to real-life will surely depend on:*  
- The ability to recognize cues within a real-life episode that are analogous to a simulated episode
- Recollection of the strategies used to manage that episode

**Factors that enhance episodic memory during simulation**

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| Scenario realism | Simulator training encourages individuals to use mental rehearsal to improve their performance.
| Instructional similarity between simulation and practice | Include clear goal setting to ensure effective performance. |
| Behavioral parallel | Include a variety of factors, including emotional and physical sensations, behaviors undertaken, triggers of action, and knowledge learnt. |
| Immersive environment | Include scenarios that are highly immersive, with the event shaping the memory. |
| It may be useful for explaining why simulation works | These factors contribute to the effectiveness of simulation training. |
| Furthermore, we should use advances in cognitive science to improve the design of simulated training scenarios | Use advances in cognitive science to improve the design of training scenarios. |

**Conclusion 3.**

- Simulator training is highly episodic in nature, with the event shaping the memory.
- We must use knowledge of episodic memory systems to understand the impact of simulator training upon real-life performance.
- It may be useful for explaining why simulation works.
- Furthermore, we should use advances in cognitive science to improve the design of simulated training scenarios.
- For example, an analysis of simulator studies has shown...
Summary

- Cognitive psychology principles may be highly useful for understanding and developing training.
- Firstly, research on team situation awareness shows how interactions between team members shape cognition (and learning) on the ward.
- Secondly, episodic memory theory is insightful for showing how training in the simulator can be transported to the real world.

Questions?

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References