Diagnostic errors in medical education: Where wrongs can make rights

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Conclusions

• Mistakes are necessary when trying to induce learning

• Diagnostic strategies that avoid one type of error may increase the rates of another type
No one likes to make mistakes.

For a civil engineer, there’s no such thing as a “little mistake.”
Avoidance of mistakes can create problems.

"It says here 50% of all marriages end in avoidance behaviour."
Caveats

• Promoting errors is not about reducing patient safety

• Mistakes are not simply the result of individuals’ decision-making

• Nor are they indicative of lack of dedication/ability of health professionals
Not all mistakes are avoidable

"I can't believe you just stood there and *let* the glacier run over your foot!"
Considerations

• Errors that arise while learners are learning new material

• Errors in understanding how well said material was learned

• Errors educators can use/induce to facilitate learning
1. Learner
2. Teacher
3. Material
CARELESS

Thinking you are at the top of the food chain is a great way to end up on the bottom of the nutrition pyramid.
Overconfidence

• Premature closure
• Lack of insight
• God complex
• Lake Woebegone

See Berner and Graber (2008); Crosskerry (2002)
Self-regulated learning

- Requires deciding:
  - What to study
  - How long to study
  - When to stop

See Nelson and Narens (1994)
### Massed Training vs. Spaced Training

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Massed Training</th>
<th>Spaced Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few, Intense</td>
<td></td>
<td>Many, Spread out</td>
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Desirable difficulties

• Conditions that are perceived as slowing down learning and that elicit more errors are often beneficial

See Bjork (1999); Simon and Bjork (2001)
Fig. 3. Mean normalized time performance curves from pretest (0%) to the point of self-assessed proficiency/posttest (100%), during additional practice, and on retention testing.
• Proficiency is inferred from the rate of learning rather than the amount learned

See Kornell and Metcalfe (2006)
Summary

• Errors are more likely to be made over the long term if they are not induced during learning

• There is a clear need for external guidance and feedback
Three maxims

• Feedback is good

• The more immediate, often, and accurate, the better

• Errors in medicine proliferate because feedback is often unavailable
constructive feedback

ur doin it wrong
Boehler, et al. (2006)

Performance Rating

- Compliment group
- Feedback group

Pre-test | Post-instruction | Post-feedback

0 | 5 | 10 | 15 | 20 | 25
A contradiction?

• Feedback should reduce errors

• Errors improve learning

• Shouldn’t feedback impede learning?
A reconciliation

• How feedback is delivered matters

• There is no one-size fits all approach

• See Shute (2008); Kluger and DeNisi (1996)
Eva, et al. (Unpublished)

Overall R=0.34
A reconciliation

• Feedback should be corrective while pushing students beyond their current level of understanding

• See Dweck (2000)
A reconciliation

- Feedback should follow the active generation of errors
  - See Larsen et al. (2008)
Test-enhanced learning

Retention Interval
- 5 Minutes
- 2 Days
- 1 Week

Percent Recall
- Study, Study
- Study, Test

Roediger and Karpicke (2006)
Summary

• Learners rarely induce in themselves the sorts of errors that maximize learning

• Educators must facilitate growth from errors and empower learners to make errors
Learner

Material

Teacher

Outline
I LOVE PARIS IN THE SPRINGTIME
The source of all evil

- The use of pattern recognition by novices is not advocated for fear that “[i]nadequate experience might lead to potentially grim consequences”

What else could it be?

Is there anything that doesn’t fit?
Overcoming the evil

• “Cognitive forcing strategies … are designed to prevent clinicians from pursuing a pattern recognition path that will typically lead to error”

• See Crosskerry (2002)
Non-exclusivity

Non-analytic processes  Combined  Analytic processes

See Eva (2005)
Ark, Brooks, and Eva (2006)

Diagnostic Accuracy

- Feature First
- First Impression
- Combined

Old ECGs

New ECGs
Ark, Brooks, and Eva (2006)

The bar chart shows the feature calls for different categories:
- **Hits Indicative**
- **Hits Not Indicative**
- **False Alarms**

The categories are represented by three types of bars:
- **Analytic**
- **Non-analytic**
- **Combined**

The y-axis represents the feature calls ranging from 0 to 2, and the x-axis categorizes the different types of hits and false alarms.
Summary

• We need to structure experiences for students that help them recognize that exclusive reliance on non-analytic processes does create error …

• … but so does absolute aversion to those same processes
Strategies for doing so

- Manipulating order of examples
- Inducing learners to compare and contrast cases
- Actively engaging learners in problem solving

- See Eva, et al. (1998); Eva (2009)
The grand finale

• Dominant discourse around diagnostic error: Heuristics bad

• Problems arising from that discourse:
  • This view overlooks the fact that any strategy can lead to errors though they are of different types
  • Reinforces the tendency for students to want to be right rather than to learn how
“An expert is a person who has made all the mistakes that can be made in a very narrow field.”

(Niels Bohr)
Thanks

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See Eva (2009; AHSE) for more detail