HOW WE KNOW
what isn’t so

Nicole N. Woods PhD
WE KNOW BASIC SCIENCE IS ESSENTIAL
WE KNOW
BASIC SCIENCE IS ADVANCING
WE DON’T KNOW HOW MUCH
WE DON’T KNOW WHEN

$$\mu_n = \int r^n \rho(r) \, dr$$
WE DON’T KNOW WHY
Knowledge of science is considered the foundation of being a ‘good doctor’

The majority [of students] naturally think of the individual patient and his illness as the important goal. Therefore, they are inclined to find the meticulous study of anatomy, physiology and biochemistry rather boring...they think their study a waste of time...to what extent has the teacher of medicine or surgery or gynecology and obstetrics employed the knowledge, language and techniques of these subjects in the teaching of his own?

J.C. Meakins (1937)
McGill University
WE DON’T KNOW
Basic science and clinical teachers agree on the required amount of clinical content for medical students at graduation.

Concerning basic science knowledge on the organ-, cellular- and molecular content level, basic science teachers judge that at graduation medical students should have deeper knowledge.

In comparison to basic science teachers, clinical teachers think less basic science should be included in the curriculum.

Exposure to medical school and the realities of clinical practice can make both sides even more convinced of their original position.
WE KNOW
WHAT ISN’T SO
The Value of Basic Science in Clinical Diagnosis


(2006) Academic Medicine, 81(10 Suppl), S124–S127
Basic Science Instruction

Study Phase (15 – 20 minutes)

Supporting Basic Science Quiz

Supporting Feature List Quiz

Recall Quiz

Diagnostic Test

One-Week Delay

Diagnostic Test (novel)

Supporting Quiz (novel)

Recall Quiz
Mean Score (% Correct)

- Basic Science
- Feature List

Immediate vs. Delayed
WE KNOW

The integration of basic science leads to retention of diagnostic performance over time

How do we know what isn’t so?
EXPERTISE
changes our perception
VIEWPOINT
of a novice
The **Stroop** Effect

- Ignore the shape
- Only identify the color of the object
- Go as fast as you can
The **Stroop** Effect

- Ignore the shape
- Only identify the color of the object
- Go as fast as you can
Green
Blue
Green
Red
Blue
Green
Red
Expert perception is automatic and difficult to “suppress”
Experts automatically bring their own lens to problems.
Basic science experts automatically bring their scientific lens to medical problems
Expert physicians report not using their basic science knowledge to solve clinical problems.
Biomedical knowledge can become encapsulated in clinical knowledge as expertise develops.

EXPERTS
May be unaware of the influence of basic science knowledge
Speed kills?
Speed, accuracy, encapsulations and causal understanding

Woods NN, Howey EHA, Brooks LR & Norman GR

(2006) Medical Education, 40(10), 973–979
<table>
<thead>
<tr>
<th>Causal Learning Instruction</th>
<th>Feature List Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Phase</td>
<td>Comprehension Quiz</td>
</tr>
<tr>
<td>(15 – 20 minutes)</td>
<td>(8 cases)</td>
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<tr>
<td>Comprehension Quiz</td>
<td>Recall Quiz</td>
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<tr>
<td></td>
<td>Diagnostic Test</td>
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<td></td>
<td>(8 cases)</td>
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<td></td>
<td>One-Week Delay</td>
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<td></td>
<td>Recognition Memory Test</td>
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</table>
Performance on unconscious memory task

- Features: High percentage of "Correct" Responses
- Inferences/Encapsulations: Moderate percentage of "Correct" Responses
- Foils: Low percentage of "Correct" Responses

Legend:
- Feature List
- Causal
WE KNOW

Instruction that integrates basic and clinical science can lead to ‘instant expert’ performance on unconscious memory tasks

The influence of basic science can be subtle and unconscious.
WE DON’T KNOW SEE WHY
Exploring cognitive integration of basic science and its effect on diagnostic reasoning in novices


Perspectives on Medical Education 5:147–153.
<table>
<thead>
<tr>
<th>Basic Science (Anatomy) Instruction</th>
<th>Feature List (Epidemiology) Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study Phase</strong> (15 – 20 minutes)</td>
<td></td>
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<tr>
<td>Recall Quiz</td>
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<tr>
<td>Diagnostic Accuracy Test</td>
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<tr>
<td>One-Week Delay</td>
<td></td>
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<tr>
<td>Diagnostic Test (novel)</td>
<td></td>
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<tr>
<td>Diagnostic Justification Test</td>
<td></td>
</tr>
<tr>
<td>Recall Quiz</td>
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</tbody>
</table>
You have diagnosed your patient with Dupuytren contracture.

The patient has now asked you to justify (DXJ) your diagnosis. In the box below, please provide your patient with a detailed explanation for the diagnosis. Be as specific as possible. There is no space limit for this question.
<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>identifies</td>
<td>Identifies incorrect sign or symptom</td>
<td>Identifies 1 correct sign or symptom</td>
<td>Identifies 1 KEY sign or symptom</td>
<td>Identifies 1 KEY sign or symptom</td>
<td>Identifies 1 KEY sign or symptom</td>
<td>Identifies &gt;1 KEY sign or symptom</td>
<td>Identifies &gt;1 KEY sign or symptoms</td>
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<tr>
<td></td>
<td>but no rationale</td>
<td>&amp; provides a correct rationale</td>
<td>but no rationale</td>
<td>&amp; provides a correct rationale</td>
<td>but no rationale</td>
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<tr>
<td></td>
<td>May also identify</td>
<td>for the</td>
<td>Also, identifies</td>
<td>for the</td>
<td>for the</td>
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<td>incorrect signs or symptoms</td>
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<td>symptoms</td>
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Performance on Immediate and Delayed Diagnostic Tests

Main effect of group: $P<0.01$
Main effect of time: $P<0.01$
<table>
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<td></td>
<td>Identifies incorrect signs or symptoms</td>
<td>Identifies 1 correct sign or symptom</td>
<td>Identifies 1 correct sign or symptom &amp; provides a correct rationale</td>
<td>Identifies 1 KEY sign or symptom &amp; provides a correct rationale</td>
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<td>Identifies &gt;1 KEY sign or symptom &amp; provides a correct rationale</td>
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Integrated basic science instruction improves conceptual coherence and application of clinical knowledge.
Our assessments can make this conceptual coherence invisible
Dental and Dental Hygiene Students’ Diagnostic Accuracy in Oral Radiology: Effect of Diagnostic Strategy and Instructional Method


Journal of Dental Education 78(9):1279-1285.
Basic Science | Structured Algorithm

Study Phase (15 - 20 minutes)

Recall Quiz

Diagnosis First | Features First | Diagnosis First | Features First

One-Week Delay

Diagnosis First | Features First | Diagnosis First | Features First

Recall Quiz
Performance on immediate diagnostic accuracy test by learning condition and diagnostic strategy

- **Basic Science**
  - Diagnosis First: 0.68
  - Features First: 0.66

- **Algorithm**
  - Diagnosis First: 0.7
  - Features First: 0.58
Performance on delayed diagnostic accuracy test by learning condition and diagnostic strategy

- Basic Science
- Algorithm

- Mean % correct

- Diagnosis First
- Features First
Clinical instruction can (un)intentionally make underlying knowledge invisible.
The Novice sees the world and processes problems in different ways than the expert.
The subtle and fragile nature of basic science does not lessen its value.
Instruction and assessment should be based on science rather than our own ideals.
What we know what isn’t so
Thank You

Mariam Baghdady
Kristina Lisk

Medical Council of Canada
Higher Education and Quality Council of Ontario

Doug Buller

www.thewilsoncentre.ca
HOW WE KNOW
what isn’t so

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