Key points

1. Scope of Problem
2. Cognitive Efficiency: Construct of Strategic Reasoning
4. Advance basic science in strategic reasoning as a construct of higher-order cognition
   • Framework for Strategic Reasoning
   • Tackling Strategic Memory and Reasoning Decline in Teens
Teen Brain Years: Scope of Problem
Age of Greatest Vulnerability and Potential
Critical Thinking:
US Ranks 24th out of 29 Developed Countries

Dallas-Fort Worth students struggle with TAKS' short-response written

Friday, July 25, 2008
By LAURIE FOX and HOLLY K. HACKER / The Dallas Morning News

Assessing language arts skills

High school students do well overall on the English language arts TAKS, which is mostly multiple-choice, and the essay portion. But when they’re asked to read a short passage and write critically about it, they do much worse. The overall passing rate is calculated from scores on three parts: multiple-choice questions, which carry the most weight, the short-response questions and an essay. The passing rate for an individual section can be higher than the overall rate. Critics argue that the short-answer portions are graded on a tougher scale than the essay portion. Here’s a sampling of local district passing rates on the 2008 exam:


- Overall
- Essay**
- Short answer*

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<tr>
<th>Grade</th>
<th>Carroll</th>
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<th>Garland</th>
<th>Highland Park</th>
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*Passing rates are based on the average scores of three short-answer questions that are asked.
**Passing rates are based on the percentage of students giving “somewhat,” “generally” or “highly” effective answers.
NOTE: The essay portion does not apply to the ninth grade.

SOURCE: Dallas Morning News analysis of testing data from Pearson Educational Measurement

TOM SETZER/Staff Artist
Translational Approach

Multi-dimensional Assessment and training

Identify Risk Genes

Impact on Real life

THE UNIVERSITY OF TEXAS AT DALLAS

EEG

Establish Brain Baseline

fMRI

Brain Response to Training +/- Drug

Chart response over time

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Abstract versus Detail meaning

• One of brain’s most robust functions is capacity to extract generalizations (Gabrieli, 2004)
  – Verbatim details fade rapidly
  – Abstracted meaning persists over longer intervals (Radvansky et al., 2001)

• Tasks eliciting abstract meaning of complex verbal content
  Summaries – Main ideas-Interpretive statements
Cognitive Operations Pivotal to Strategic Reasoning

- **Strategic Filtering**
  Function: Filtering of relevant from irrelevant

- **Abstracting coherent meaning from detail component meaning**
  Function: Dynamic process of updating abstracted meaning from the details

- **Innovative Questioning**
  Function: Using information to generate novel questions/issues/solutions

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Empirical Studies

- Traumatic Brain Injury
- Attention Deficit/Hyperactivity Disorder
- Normal cognitive aging
- Mild cognitive impairment and early Alzheimer's
- Typically developing teens
Detail Component Meaning (DCM)
Strong Recovery in Pediatric Brain Injury

Evaluations

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Abstracted Coherent Meaning (ACM) Stalled Recovery in Pediatric Brain Injury

Evaluations

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Younger Age at brain injury: Lower Abstracted coherent meaning skills
Middle School Brain Crises In ADHD: Stall in Abstracted Coherent Meaning

Stall in Reasoning

BrainHealth Team Discovery

Recall of Details

Children with ADHD


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Cognitive marker of Normal Aging vs. Pathology


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Detail Component Meaning


© Center for BrainHealth®
Cognitive marker of Normal Aging vs. Pathology

FIG. 1. (Chapman, Zientz, Weiner, Rosenberg, Frawley, and Burns). Scatter plot of individual gist-level responses for the three groups (A = mild AD, M = mild cognitive impairment, N = normal controls) on main idea (x-axis) and lesson (y-axis).


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Potential Moderator Variables in Strategic Reasoning

- Intelligence – fluid/crystallized
- Attention
- Inhibition
- Episodic Memory
- Working Memory
- Language comprehension & expression
- Binding to form abstract or novel ideas
- Education experience
Investigating brain bases for Strategic Learning

Key:

1. Identify brain mechanisms associated with strategic reasoning success/failure

2. Develop and test training to enhance strategic learning and teen brain development with pre and post measurements
Multi-Level Metrics of Strategic Reasoning

Binding details to form abstract meaning

Strategic Reasoning Matrics

Word level
1. Categorical
   (desert; hump → camel)
2. Synonyms
   (gossip; rumor → Yes quantity; quality → No)

Sentence level
1. Proverbs
2. Theme/Details
   Sentence Picture Matching

Discourse Level
1. Interpretation
2. Theme
3. Summary

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Difference in brain function (SPECT): Good vs Poor Recovery in Abstract Coherent meaning

Positive Covariance
Less recovery associated with decreased brain blood flow in Rt. Superior Frontal
Topographical maps of factor loadings (spatial factors) that showed differences between gist and details (Anand, 2008)

Significant Differences between Gist and Details ($p = .005$);
Time Range: 690-850ms; 1000-1070ms

Significant Differences between Gist and Details ($p = .002$);
Time Range: 750-950ms

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Advance of Basic Science to Guide Education Practices

- Educators/scientists often adopt instructional principles based on superficial understanding of complexity of brain and cognitive functions.

- Studies are needed to examine strategic reasoning with rigorous control over moderator variables.
Investigating Brain Bases for Strategic Learning

• Which brain networks are involved when processing abstracted and detail information?
  – Correctly
  – Incorrectly
  – Inefficiently

• How does training of each (abstract – detail) modify brain activation patterns, behavior, and learning?
Investigating Brain Bases for Strategic Learning

• Does training of one (detail ↔ abstract) transfer to the other and to novel learning contexts and academic performance?
• Which direction of training is most efficient? Top – down versus Bottom-up
• Appropriate age to train strategic reasoning?
Theoretical Issues

- Is memory for detail component meaning prerequisite for constructing abstract meaning?
- Are detail and abstract meaning compromised in a parallel, but not causative relationship?
- Can poor memory for detail meaning co-occur with good abstract coherent meaning?
Strategic Reasoning

- Underlies ability to acquire new meaning
- Draws upon and expands pre-existing knowledge
- Relates to innovative thinking and insight
- Provides the basic building blocks for generalization to solving new problems
Strategic Reasoning
Applicable to Multiple Domains

• Educational training
• Industry (e.g., Systems engineers)
• Business productivity
• Retirement Planning
• Healthy Brain Aging
• Brain Rewiring after injury
Strategic Memory and Reasoning in Teens

• To understand behavioral and brain basis of strategic reasoning
• To identify factors that influence strategic reasoning
• To evaluate the significance of strategic reasoning in determining academic and vocational success
• To determine the effects of strategic reasoning training in various clinical populations using behavioral and brain imaging measures
• To identify factors (e.g. dose) that determine maximal change with strategic intervention training