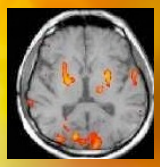

Seven Trade-Offs That Create

Cognitive Diversity in the Classroom

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Dyslexic Advantage.com

http://slideshare.net/drseide

Understanding Children: The Five "DyNaMITE" Perspectives

1. **Development**
2. **Neurobiology ("wiring")**
3. **Motivation/Interest**
4. **Temperament**
5. **Experience**

Today's focus on the perspective of Neurobiology:

or the brain-based sources of cognitive differences

Key Point

There isn't a single type of "normal learner," or one optimal pattern of brain function.

Instead, brains can incorporate a variety of cognitive features, each of which may be better suited for some functions than others.

These cognitive features are like the ingredients in a recipe: The relative amounts and identities of each determines the "product"

Trade-Offs

Importantly, many of these cognitive ingredients" come in reciprocal pairs—so that more of one means less of the other.

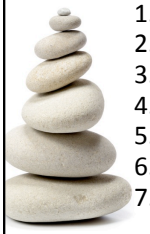
We'll discuss seven key pairs of cognitive trade-offs that together explain much of the variation in how (and how successfully) different students perform different tasks

Key Concept:
Weakness in one area often points to corresponding strength.

--So--

When you find a weakness,
Look for the corresponding strength

These are the seven key trade-offs



1. Automaticity vs. Mindfulness
2. Semantic vs. Episodic Memory
3. Analytical vs. Intuitive Reasoning
4. "Linear" vs. "Interconnected" Reasoning
5. Verbal vs. Non-Verbal Reasoning
6. Focused vs. Diffuse Attention
7. "Fine Detail" vs. "Big Picture" Reasoning

Automaticity often supported by
Procedural Learning and Memory System

- "How skills"
- Skills made automatic through practice
- Rules, procedures, rote facts
- Motor and language branches
- IQ testing: correlates with processing speed
- Achievement testing: correlates with fluency

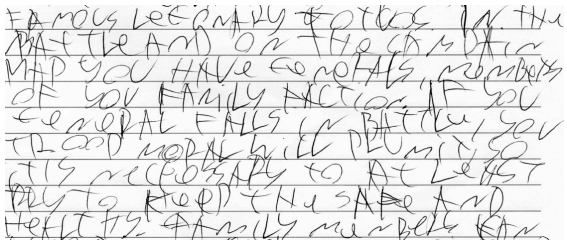
Automatic Procedural Skills

- Crucial for most "basic skills"
- Automatic, fast, efficient, reproducible
- Perform without conscious thought, so working memory can be better devoted to higher level tasks

Procedural Tasks

- Word sound segmentation, discrimination, and articulation
- Phonetic decoding and encoding
- Grammar and syntax
- Forming written letters
- Writing conventions and punctuation
- Math rules, procedures, and rote facts (calculation)
- Sequences like months and days
- Class procedures
- Motor procedures like tying laces, dressing, utensils, etc.

Lack of Automaticity in Handwriting



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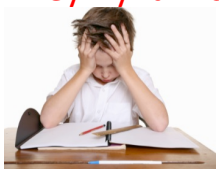
A Key Dynamic:



Inadequate automaticity requires conscious compensation—i.e., use of active working memory or a more "mindful" approach. Often leads to working memory overload.

Often diagnosed with ADHD, but attention problems are very task specific.

Also common with dyslexia, sensory processing disorder, and autism spectrum.

Pluses and minuses

Enhanced automaticity makes you fast, reliable, efficient, and readily able to focus on higher level skills when the lower ones are mastered.

Poor automaticity requires increased mindfulness, which can make you slower and more liable to overload, but also makes you more aware of what you're doing, and more liable to innovate.

Often an issue with highly creative individuals.

Two More Key Points About Procedural Learning

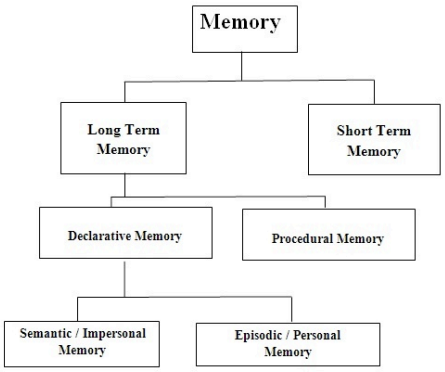
1. Implicit vs. explicit learning: implicit (observational) learning governed by procedural memory, and when poor rules must be mastered explicitly.
2. Social functions are largely procedural.

Teaching and Learning

One key is preventing the cycle of working memory overload:

- Chunking
- Focus on one procedural skill at a time
- Keyboard
- Formula Card
- Make rules explicit, using written rules, examples, etc.
- But…don't overvalue rote learning

The Branches of Memory



Different Forms of Factual Memory

- Semantic: Impersonal
- Abstract
- Non-contextual
- Generalized, Generic
- Like Dictionary Definitions
- "Completed" Patterns

- Episodic: Personal
- Scene-Based
- Specific Time and Place
- Particular, Specific
- Cases, Examples
- "Separated" patterns

Episodic Memory

Speech Professor Duane Smith:

"If I hear a song, or smell something, or see an article of clothing or a car from a particular year, I can immediately imagine a scene on a particular day, or event. It drives my wife crazy because we'll be listening to the radio, and I'll talk about how it takes me back to 1985 when I was standing with a group of buddies at In-N-Out Burger on a Saturday night listening to that song, and what we were talking about, and she'll say, 'Can't you ever just listen to the song?'"

If we say 'robin' what does that make you think of?

"Different robins, definitely. My mind starts jumping to robins that I've experienced, rather than a single generalized robin, or the Platonic ideal of the robin…"-
Jack Laws, naturalist

Episodic Memory

Advantages – store vivid individual details, attend to novelty and exceptions, rich associations and connotations, divergent thinking, ideas in context / applications

Disadvantages – hard to 'sound bite', lots of data to organize and sequence, slow, inefficient

Teaching and Learning

Teaching differences: Students who strongly favor either impersonal or personal memory will differ greatly in what they consider a distraction and what is essential.

Semantic-biased students: just the facts

Episodic-biased students may need context, cases, personal involvement, enactment, etc. to store data

One family's experience…

Analytical vs. Intuitive Approach

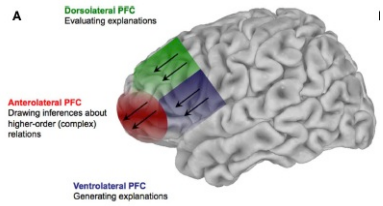
CRA Problems:

What single word can form a familiar compound word or phrase with the following 3 words?

pine – crab - sauce

Analytical Thinking

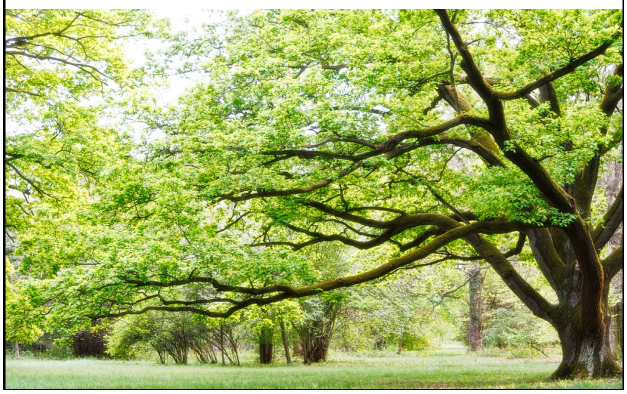
Analytical Thinking



- Conscious Process
- *Directed* Focus
- Selection, Trial-and-Error, Sequencing, Stepwise, Transparent
- Working Memory-Intensive, Tedious

Barbey and Patterson, 2011

Intuitive Thinking



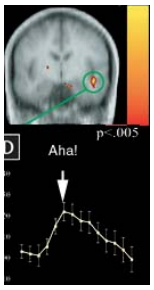
Intuitive/Insight-Based Thinking

Insight: Sudden leap, surprising, not stepwise or transparent.

"You have the answer before you are able to put it into words. It is all done subconsciously. This has happened many times and I know when to take it seriously. "
- Dr. Barbara McClintock, Nobel Prize in Medicine

Problem Stated
Incubation Period / Distraction
Sudden Discovery

"Given a problem and an hour to solve it, we spend 3 minutes intuiting the answer then the other 57 backtracking to check our results through data collection and deductive logic."
- Sarah Andrews, professional geologist, mystery writer



Jung-Beeman, 2004

"It is by logic that we prove. It is by intuition that we discover." – Henri Poincare

Intuitive Expertise

"Disgusted by my lack of success, I went to spend a few days at the seaside and think of other things. One day, while walking along the cliffs, the idea came to me…" – Henri Poincare

" I do my best thinking after playing the violin for a half hour." - Albert Einstein

"When I feel well and in a good humor, or when I am taking a drive or walking after a good meal, or in the night when I cannot sleep, thoughts crowd into my mind as easily as you could wish…" – Wolfgang Mozart

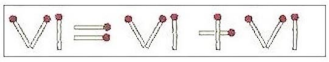
Activation of Distant or Novel Associations

Where chemists get ideas:
60% abandon problem
47% before bed
45% vacation

Root-Bernstein Discovering

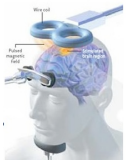
Intuitive Thinking

Turning Down & Turning Up the Brain:
(stimulate right Anterolateral PFC and inhibit left ATL)



Move one match to make the statement true.

Increase Intuitive Solutions by 2-Fold



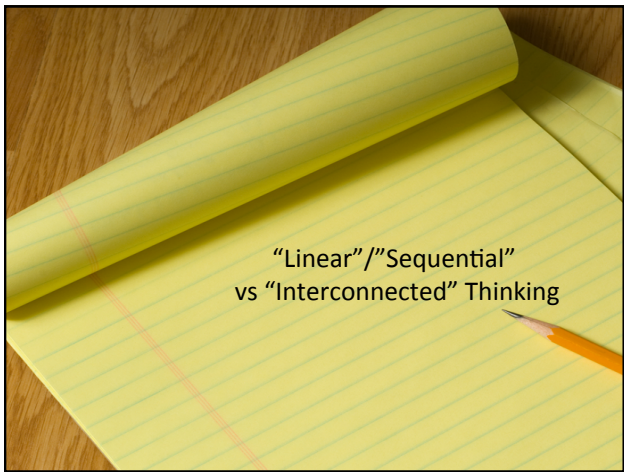
Chi and Snyder

Learning and Teaching

Analytical ⇌ Intuitive

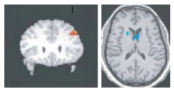
Analytical – expert tips, organize information, systematizing

Intuitive – recognize 'not working' pattern, more time, longer projects, musing

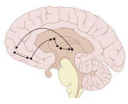


Linear Thinking

Algorithmic, systematic
Direct, Primary Definition
Deductive
Sequential
Quick



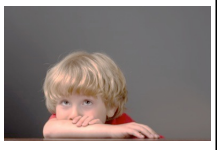
Filoteo, 2004

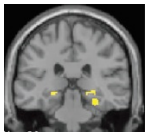


Frontostrial Circuits

Interconnected Thinking

Indirect , Analogical,
Exceptions to Rule,
Divergent,
Secondary (distant) connections
Slow, Doesn't run on timetable





Medial Temporal Lobe

e.g.: opposite of "up"

Simple vs. Real World Problem Solving

- Well-defined question
- One or limited solutions
- Defined methodology

- Poorly defined questions
- Multiple or unknown solutions
- No clear methodology

Learning and Teaching

Linear ⇄ Interconnected

Make time for unstructured problems
Problem scoping

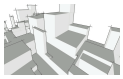
Bring the real world into the classroom

Verbal vs. Non-Verbal Thinking

Words vs. Non-Words (Visual, Spatial, Sensory)

Visual

Spatial/
Topographical

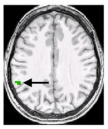


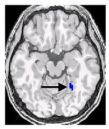
Sensory/Movement

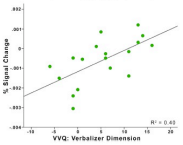
Verbal and Visual Thinkers Differ with Words and Pictures

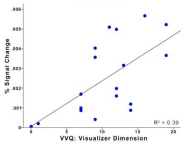
Verbal Thinkers Process Pictures Through Verbal Areas

Visual Thinkers Process Words Through Picture Areas









Kraemer & Thompson-Schill

Different Styles of Expertise

"Words are totally absent from my mind when I really think."
- Jacques Hadamard, mathematician

"Sometimes I do imagine the ideas as if they were a machine…. Sometimes I imagine there are parts to them and there are lever arms and there are parts that you turn. You turn this a little bit here and something big happens over there. I can sort of see the connection of it…there is a kinesthetic component to it."
– Matt Schneps, astrophysicist

Learning and Teaching

Recognize the translation process between words and non-words. Process of "translation" must be consciously learned.

Expression will be easiest in the preferred system

Non verbal thinkers – projects, schematics, Cues and prompts

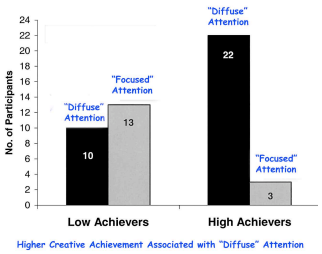
Focused Attention

Diffuse Attention

Diffuse Attention
(Reduced Latent Inhibition)

- Reduced ability to screen irrelevant stimuli from conscious awareness (distractible!)
- Associated openness to experience, increased creativity
- 'Permeability of Consciousness'

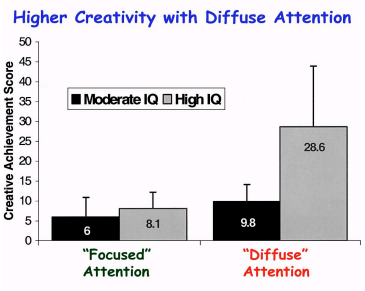
Diffuse Attention dominates in high creative achievers:



Higher Creative Achievement Associated with "Diffuse" Attention

Carson, 2003

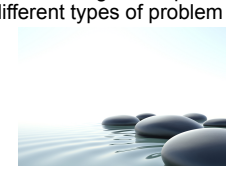
Diffuse Attention Correlates More Closely Than High IQ With Creativity



Carson et al 2003

Focused Attention

Focused attention training can improve working memory and different types of problem solving

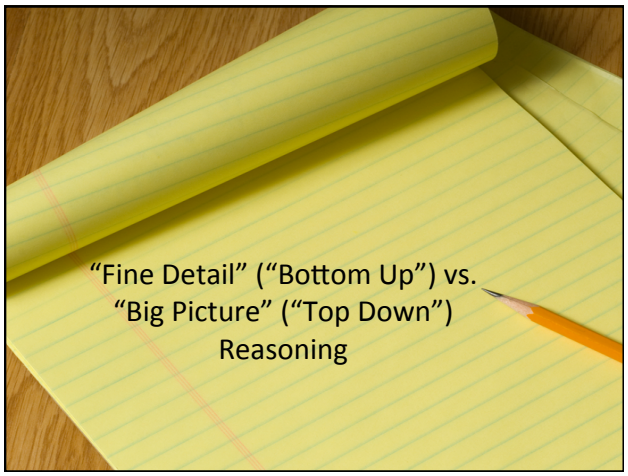


Learning and Teaching

Focused Attention ⇄ Diffuse Attention

Focus can be sharpened

Awareness can be broadened



Function Correlates with Structure

Cognitive functions emerge as circuits are formed between functional clusters of brain cells (called minicolumns).

Connections between adjacent clusters of cells with similar functions results in enhanced fine detail functions like expert precision, speed, detail resolution, and efficiency. E.g., upgrading processer without adding functions can make a good calculator even better.

Connections between distant clusters results in enhanced "big picture" functions like gestalt, gist, or context detection, judgment, etc.

Autism (local circuits) vs. dyslexia/adhd (distant circuits)

Fine Detail vs. Big Picture

- Fine details: discriminating closely related sounds, visual images, concepts, terms, etc.; performing simple tasks quickly and accurately (e.g., calculations, spelling, grammar, precise motor movements); precise definitions and distinctions. Trees vs. forest. Handwriting, phonics, names and dates, Where's Waldo…
- Big Picture: Context, gist, theme, symbolism, judgment, distant connections. Reading faces, poetry, literature, historical and political theory, process.

Teaching and Learning

- Fine Detail: Bottom up, details first, build picture as you go.
- Big Picture: Top down, sketch big picture first, fill in details later. Need to 'hang' new concepts onto old ones.

Future Directions

Better understanding of differences leads to better teaching and use of skills.

1. Automaticity vs. Mindfulness
2. Semantic vs. Episodic Memory
3. Analytical vs. Intuitive Reasoning
4. "Linear" vs. "Interconnected" Reasoning
5. Verbal vs. Non-Verbal Reasoning
6. Focused vs. Diffuse Attention
7. "Fine Detail" vs. "Big Picture" Reasoning

Most teaching directed to left member of these pairs.
This needs to change!