

“The purpose of an educational institution is to lead the students, who initially believe the educational institution is there to educate them, to the realization that they must educate themselves.”

“They must ...learn how to learn
[integratively]...”

From Willis Hurst, MD, Medscape
[and Pelley]

Teaching Clinical Thinking: Transforming Clinical Students Into Problem Solvers

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Main Points Today

1. Experts can learn to understand novice thinking.
2. Self-awareness is not optional.
3. Higher order thinking skills are “*Back To The Future.*”
4. Students must transform themselves from “receiver” to “producer.”

Concepts Covered

- Personality preferences in thinking
- Correlates from brain research
- Dreyfus model of skill acquisition
- Complexity science/chaos theory

BEGIN WITH COMPLEXITY/CHAOS

Students And Patients As Complex
Systems

“I Think, Therefore...”, Descartes

- Logical, reductionist thinking – only what we see clearly is true
 - Underpinning for science; controlled experiments
 - Underpinning for traditional medical curriculum
- Influenced Newtonian cause-and-effect physics; linear relationships
- Effective with machines; ineffective with people (complex, holistic)

Humans As Complex Systems

- “Patients Don’t Read The Textbooks”
- Chaotic (unexpected) outcomes
- Small cause → big effect (system-wide)
- “Attractors” influence outcomes
 - Teaching style can be an “attractor”
- Self-organization of knowledge
- Learning skilled thinking includes both linear and holistic views

SKILL ACQUISITION: DREYFUS MODEL

A “Self-Organizing Behavior”?

Learning From Experience

(JAMA. 2002;287:243-244)

**Novice → Advanced Beginner → Competent →
Proficient → Expert**

Initial Thinking Is Linear

- A. Initial reliance on abstract rules
- B. Initial regard for equal relevance of all information
- C. Initially outside the situation as observer

Self-Organization Of Knowledge Is Holistic

- A. Increasing reliance on concrete experience
- B. Increasing regard for important information within a system
- C. Increasing engagement as a performer

Novice (MS3)

- Rule adherence
 - All data are equal
 - Context independent
- Example – Myocardial Infarct: Novice student obtains an EKG for chest pain, without other modifiers.

Advanced Beginner (early PGY1)

- Rule recognition
 - Meaningful situational components
 - Decisions by rule application
 - No personal responsibility
- Example – Myocardial Infarct:
Dyspnea also might be associated with cardiac ischemia; orders an EKG

Competent (PGY2)

- ▶ Standardized organizing principles and planning
 - Still context dependent
 - Overall picture lacking
 - Emergence of responsibility for decision-making
- ▶ Example – Myocardial Infarct: Multitude of factors influencing likelihood of ischemia; decision tree to allocate probabilities – pattern recognition emerging

Proficiency (Board Eligible)

- Discriminating, holistic
 - Guided by maxims
 - Faster decisions
 - Decisions still conscious
- Example – Myocardial Infarct:
Realizes “this is an infarction” and then applies rules to decide about thrombolysis.

Expert (5-10 years out)

- Rapid intuitive grasp
 - Vision
 - Unaware of thinking “process”
- Don’t solve problems; do what works
 - Pattern recognition extends to plan as well as diagnosis
- Example – Myocardial Infarct:
“This is an infarction and we should implement the following diagnostic and therapeutic interventions.”

When Expertise Fails

- The expert uses rules and explicit decision-making.
- The “expert” becomes a novice.

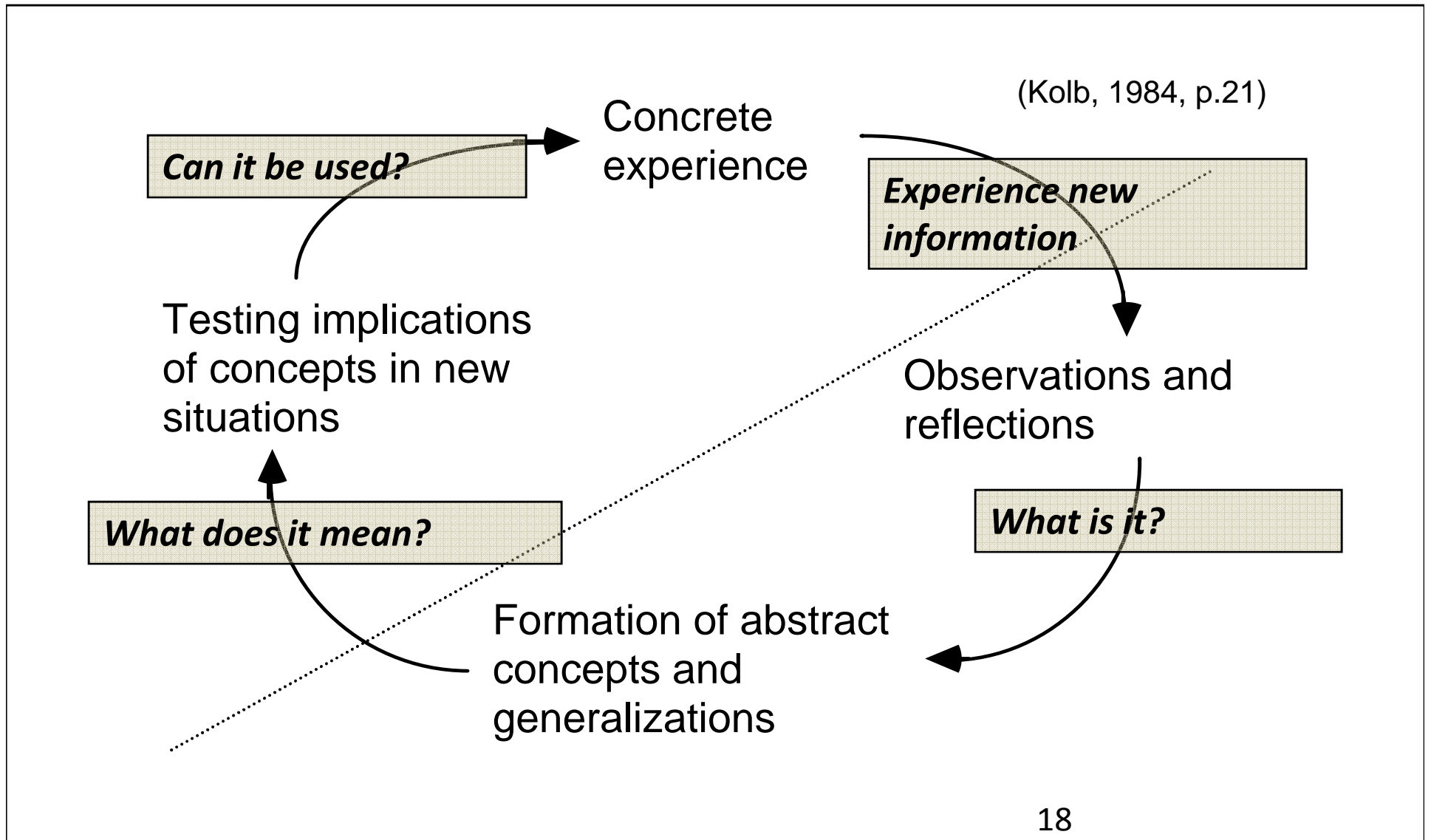
Summary Of Skilled Thinking

- Skilled thinking requires:
 1. clear logic initially (rules and facts)
 2. adaptation to complexity (experience)
- Brain “self-organizes” knowledge from experience
- Progression to each stage happens spontaneously

HOW DO WE PROCESS EXPERIENCE?

The Brain Designed To Change Itself -
Physically and Functionally

Experiential Learning Model



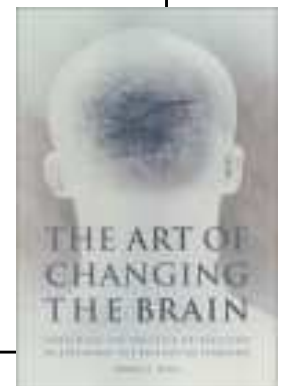
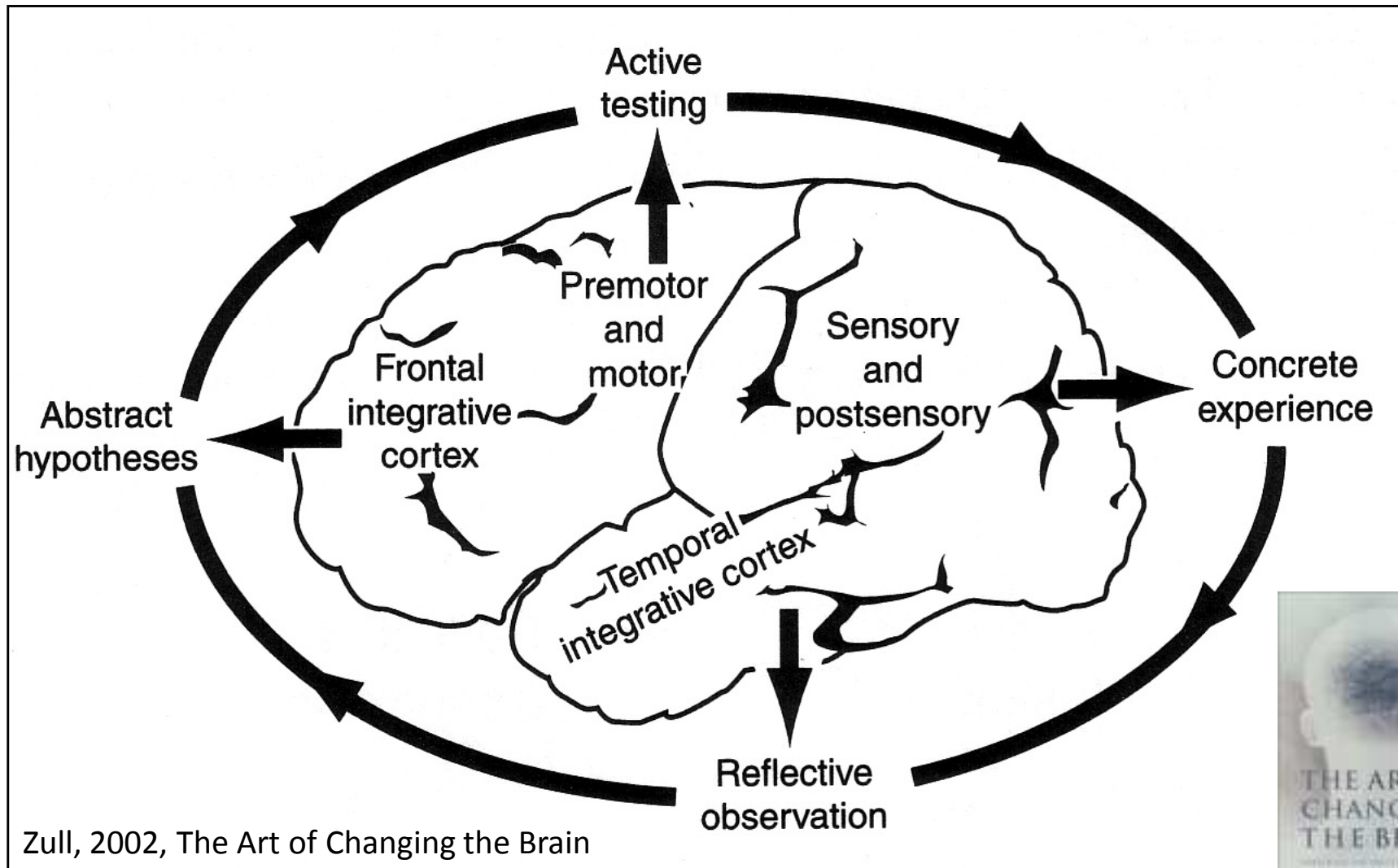
Learning Is A Process As Well As An Outcome

- Four main stages of processing (from Zull)
 1. Sensory input distributed to→
 2. Temporal cortex for integration with what is already learned which is used by→
 3. Prefrontal cortex for integration with future generalizations/options that can then lead to→
 4. Action by the motor cortex which lies behind the frontal cortex

(Learning Cycle Figure Next Slide)

The Learning Cycle

David Kolb adapted by Zull



What Happens If Active Testing Is Not Done?

- The brain protects itself by forgetting.
- The hippocampus “re-runs” previous activity during sleep.
 - Only significant (emotional) experience is retained in long term memory
 - 5 REM cycles required
- Prefrontal decision making creates “producers” out of “receivers”

WHAT ARE THE WAYS THAT THE BRAIN CAN PROCESS INFORMATION?

The Quellmalz Learning Taxonomy

Levels Of Complexity

- Recall (linear) – “Just the facts ma’am”
- Analysis (grouping, indexing) – How are facts grouped into patterns?
- Comparison (pattern) – How are patterns related?
- Inference (pattern understanding) – What is concluded? [diagnosis]
- Evaluation (vision) – What is predicted? [clinical treatment and management]

Complexity Stated In Learning Objectives

- Recall – Define hyperglycemia, ketoacidosis, glycosylation.
- Analysis – Give the characteristics of type 1 diabetes.
- Comparison – Explain how type 1 and type 2 diabetes are both similar and different.
- Inference – Justify your diagnosis of type 2 diabetes.
- Evaluation – Develop a treatment plan for a type 2 diabetic.

Back To The Future

- Temporal (back) processing looks at
 - Facts, grouping, learned patterns
 - Uses Recall, Analysis
- Frontal (future) processing looks at
 - “Discovered” grouping, new patterns, inferences, evaluation of options
 - Uses Analysis, Comparison, Inference, Evaluation

Midpoint Recap

- Learning is a self-organizing function of the brain.
- Expert thinking skills are acquired by “processing experience.”
- Experiential learning “flows” through the cortex (information processing).
- Learning to think occurs in a cognitive hierarchy.

DO STUDENTS (AND YOU) DIFFER IN THEIR “COMFORT” WITH COMPLEXITY?

Learning Styles – Personality Correlates
With Brain Function

Personality as Thinking

- Jung observed consistent patterns of behavior (*circa* 1920's).
- Myers and Briggs developed a way to reliably identify preferences (1950's).
- Applications in private sector
 - Team problem solving
 - Leadership development.
- Applications to medical education
 - SuccessTypes (1997) Pelley and Dalley.

Myers-Briggs Personality Types

Four dimensions of preferences:

Extraversion (E) vs. Introversion (I)*

Sensing (S) vs. Intuition (N)*

Thinking (T)* vs. Feeling (F)

Judging (J) vs. Perceiving (P)*

*Pelley's type INTP

Getting In Touch With Your Thalamus

- Thalamus at base of brain
 - Distributes information to rest of brain.
- How you do your best thinking:

Talk it out first or,
Think it through first

Low Gain vs. High Gain

- Talk it out – “low gain” thalamic activity; seeking more input
 - Extraversion
 - Lower cerebral blood flow, augmentation of “evoked response”
- Think it through – “high gain” thalamic activity; reducing input
 - Introversion
 - Higher cerebral blood flow, reduction of “evoked response”

Extraversion vs. Introversion

How do you do your *best* thinking?

- Extraverts think best by “talking it out.”
 - Ready-fire-aim!
 - Talk to think
- Introverts think best by “thinking it through.”
 - Ready-aim-aim!
 - Think to talk
- Everyone does both, but only *one* is preferred.

Sensing (S) vs. Intuition (N)

What information do you give the *most* attention to?

- Sensing types give their attention to specifics. (temporal lobes)
- Intuitive types give their attention to the big picture. (pre-frontal)
- Everyone does both, but only *one* is preferred.

Thinking (T) vs. Feeling (F)

How do you react to new information?

- Thinking types consider the logical implications. (pre-frontal)
- Feeling types consider the impact on people. (limbic/emotional centers)
- Everyone does both, but only *one* is preferred.

Judging (J) vs. Perceiving (P)

How do you manage your life?

- Judging types prefer to be planned, organized (joy of closure).
- Perceiving types prefer to be flexible, adaptive (joy of discovery).
- Everyone does both, but only *one* is preferred.

“LINEARIZING PROBLEM SOLVING”

Teaching The Novice

The Jungian Mental Functions

1. Sensing – focus on data (difficult for intuitive types)
2. Intuition – focus on the possibilities (difficult for sensing types)
3. Thinking – focus on logical conclusions (difficult for feeling types)
4. Feeling – focus on impact on people (difficult for thinking types)

Clinical Reasoning – A Linear Sequence **For The Novice**

Sensing (patient data)



Intuition (differential diagnosis)



Thinking (diagnosis)



Feeling (impact on patient)

Focus on Sensing (Data)

What are the data?

- Standard H&P data collection and reporting
- What data are different from the last patient with same chief complaint?
 - Not an interpretation
- What has been done?

Focus on Intuition (Possibilities)

What do the data imply?

- What are the most important data?
- What are the possible causes?
- What are the options for solving this problem?
- What is the problem analogous to?
 - “Why is this case of CHF different from the last one we saw?”

Focus on Thinking (Objective)

For each diagnosis:

- What are the pros and cons?
- What are the logical consequences?
- What is the cost?
- What data are missing?

Focus on Feeling (Subjective)

For each diagnosis:

- How much do I care about the outcome?
- Is the outcome pleasant or unpleasant?
- Who is committed to the outcome?
- What and whose values are involved?
- How will patient and family react to the outcome?

Problem Solving Essentials

- Team contribution is critical
 - Learning “types” develop the non-preferred function faster when they hear it (experience!)
 - Develop “inter”-dependence
- Mental functions are skills, not intelligence!

Fini

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