Cognition and Learning

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Topic 2
Higher Order Mental Process

Knowledge versus Thinking

Knowledge (What to know)
PRODUCT

informs

creates

Thinking (What to know)
PROCESS
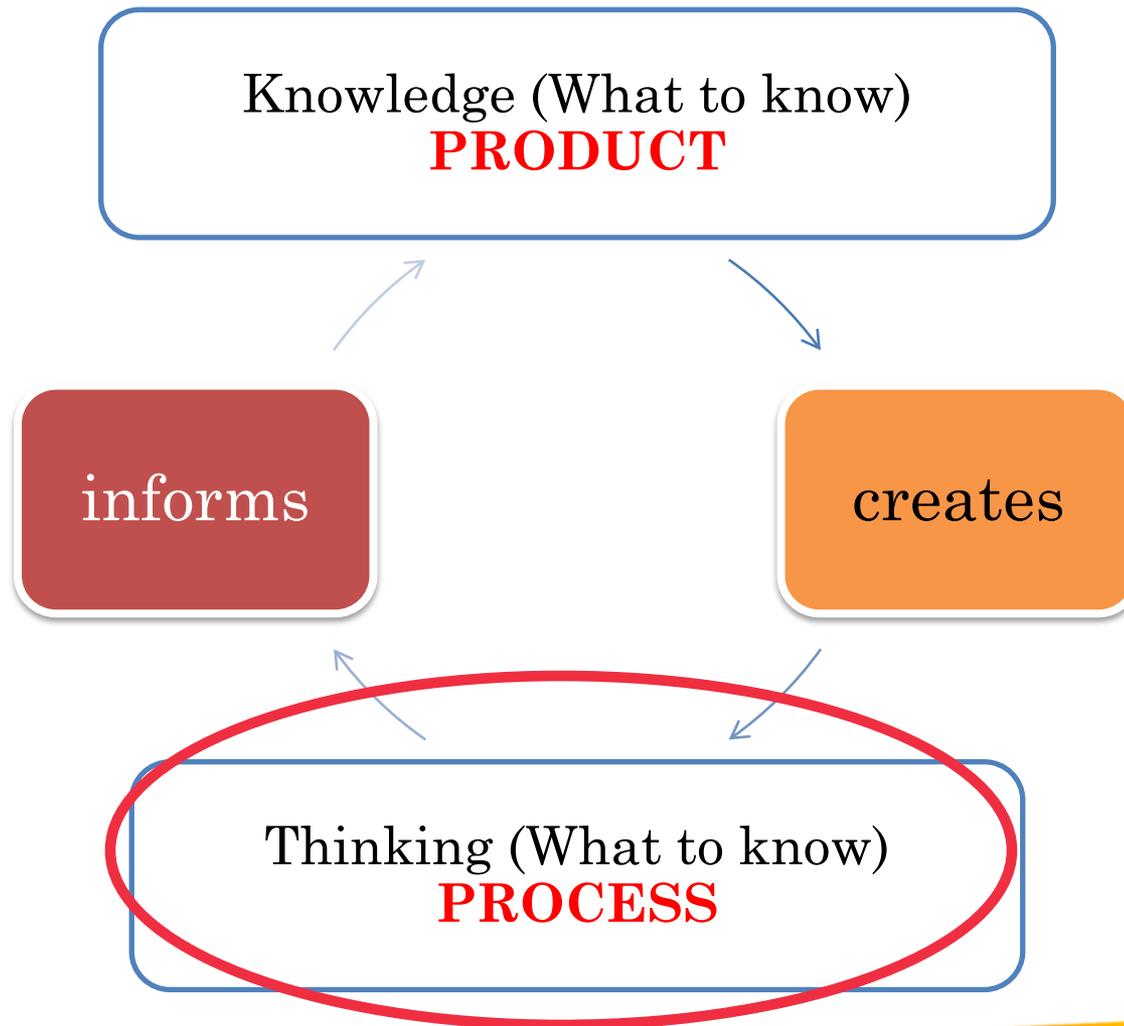
Freud: Types of Thinking *(1954)*

Primary Process Thinking

Secondary Process Thinking

Unconscious Mind

Conscious Mind

▸ Type of thinking associated with primitive drives, wish fulfillment & pleasure seeking, and has no logic or concept of time.

▸ Manifest mainly in dreams and daydreams where deep rooted wishes are fulfille.

▸ The everyday problem solving we engage in - **goal directed.**

▸ Fulfill our innate desires too <u>BUT operates within constraints of real world</u>

> ▸ Thinking & reasoning
> ▸ Logical, mature, time-oriented

The Science of Cognition
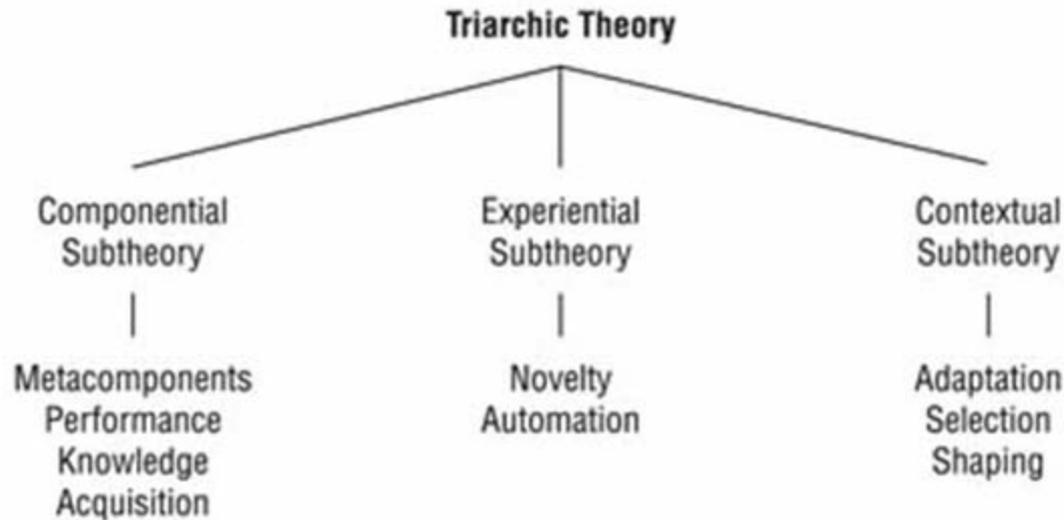
| Perception | Attention | Memory | **Thinking** |

The systematic transformation of mental representations of knowledge to characterize actual or possible states of the world, often in service of goals

THE CAMBRIDGE HANDBOOK OF
Thinking and Reasoning

EDITED BY
Keith J. Holyoak
Robert G. Morrison

CAMBRIDGE

Holyoak KJ, Morrison RG (2005) Thinking and reasoning: a reader's guide. In: Holyoak KJ, Morrison RG (eds) The Cambridge handbook of thinking and reasoning. Cambridge UniversityPress, Cambridge, pp 1–9

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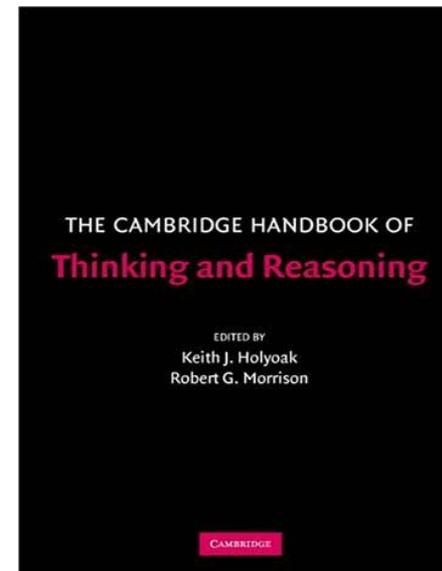
Defining Thinking:
Triarchic Theory of Intelligence

Triarchic Theory

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                    Triarchic Theory
         ┌────────────────┼────────────────┐
   Componential      Experiential       Contextual
    Subtheory         Subtheory          Subtheory
         │                │                  │
  Metacomponents       Novelty           Adaptation
  Performance        Automation          Selection
  Knowledge                              Shaping
  Acquisition
```

Illustrations by GGS Information Services. Cengage Learning, GALE.

Image Source: http://www.education.com/reference/article/triarchic-theory-of-intelligence/

Thinking: What Order?

LOTs | Lower Order | Higher Order | **HOTs**

- Involving storage and retrieval of information and often require a single correct answer, for example, when answering closed question.

- Involving cognitive processing which demand more effort in order to manipulate & transform information in meaningful ways, for example when answering open question.

DEVELOPMENTAL APPROACHES TO THINKING

Thinking: Developmental Approaches

- Assumes a progression of thought from lower forms to higher forms with experience
  - HOT – culmination of earlier achievements

Bloom's Approach	Piaget's Approach	Vygotsky's Approach	Novice-Expert Approach

Image source: http://oaks.nvg.org/taxonomy-bloom.html

Image source: http://www.biography.com/people/jean-piaget-9439915
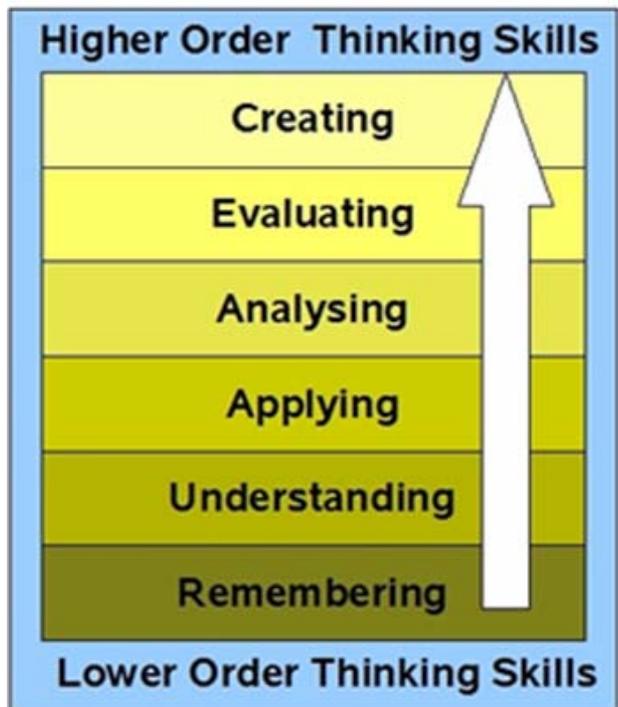
Image source: http://en.wikipedia.org/wiki/Lev_Vygotsky

Bloom's Approach on HOT
(Bloom et al., 1956; Anderson & Krathwohl, 2001)

- Illustrate the assumption that some types of knowledge are logical pre-requisites of others
  - Simpler forms of thinking to be mastered first before attempting **higher order thinking** instructions.

Higher Order Thinking Skills	
Creating	*GENERATE* new products, ideas or demonstrate new ways of viewing things
Evaluating	Make decisions based on in-depth reflection, assessment, criticism
Analysing	Dissect info to explore understandings & relationship
Applying	Use concepts, theories, strategies in new situation
Understanding	Grasp meaning by interpreting what's learned
Remembering	Recall, restate or relay facts/information
Lower Order Thinking Skills	

Piaget's Approach on HOT

Children's thinking becomes increasingly abstract and logical

Draw inferences

| Sensorimotor | Preoperational | Concrete Operational | Formal Operational |

Reasoning with symbols

- Thinking becomes increasingly **abstract** with development
  - Removed from <u>immediate perception & action</u>
    (i.e. **LOT** = sensory-motor or pre-operational thought)
  - **HOT** = concrete & formal operational thought, 'emerge' with interaction & experience (reasoning with symbols)
- Thinking becomes increasingly **logical** with development
  - Conforms to canons of logic (draw inferences)

Children of all ages are capable of cognitive operations, BUT unlikely to *correctly* apply them to real-world content until they are able to **<u>interact</u>** sufficiently with things in the world & form abstraction across experiences

Vygotsky's Approach on HOT

- Generally in agreement with Piaget
  - a progression from lower forms of thought to higher forms of thought with development
- However, a given cognitive activity reflects HOT when:
  - There is a shift of control from environment to individual
    - Other regulation – self regulation
  - Individual has conscious access to cognitive activity
    - Aware of and can articulate what he/she is doing
  - Cognitive activity has social origin
    - Interchanges between more competent & less competent individuals
  - Individual uses symbols or signs to mediate cognitive activity
    - Language
    - Private Speech

Social interaction and **language** are keys to shifting a skill from lower order version to higher order version

Novice-Expert Approach

- Recent addition to field of cognitive development
  - goal – identifying nature of expertise in some knowledge domain
- To reveal nature of expertise, observe experts & novice as they try to solve problems
  - Compare both problem solving approaches
    - Key Q = What is true of experts that is not true of novices?

Dimensions of Expertise

| Domain specificity | Greater knowledge & Experience | Meaningful Perception | Reflective, Qualitative Analysis |

| Principled Problem Representation | Effective Strategy Construction | Post Analysis Speed & Accuracy |

More on Domain of Expertise

Domain specificity	Greater knowledge & Experience	Meaningful Perception	Reflective, Qualitative Analysis
	Principled Problem Representation	Effective Strategy Construction	Post Analysis Speed & Accuracy

Genuine expertise typically limited to single domain

See meaningful whole & recognize recurring pattern

Ability to interrelate information in more complex, elaborate & abstract way

Pause to understand problem, build its workable mental representation, able to respond accurately despite time limit

Enhanced memory due to aspects of knowledge, speed, automaticity

Greater self-monitoring skills

CRITICAL & CREATIVE THINKING

Critical Thinking (Reorganized Knowledge)
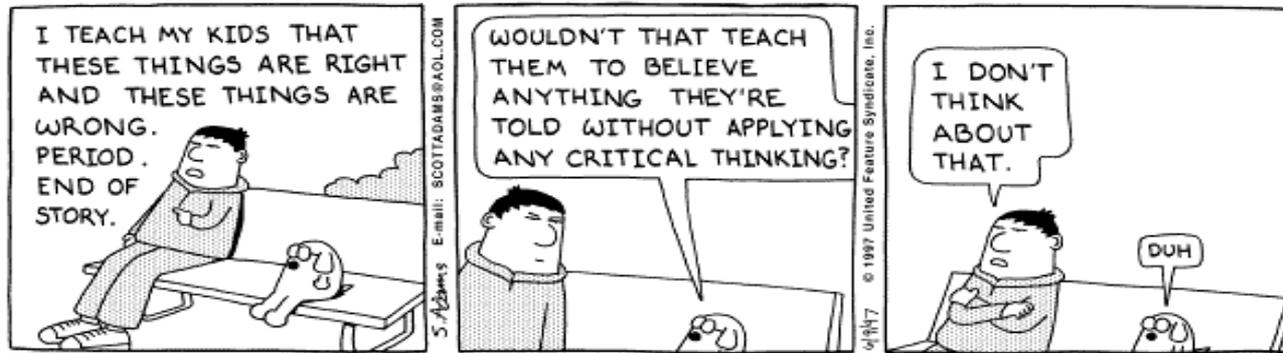

Image Source: http://www.liberator.net/humor/dilbertCRI.html

- Dynamic **reorganization of knowledge** in meaningful & usable ways.
- Three general skills:
  - Evaluating = making judgments about something by measuring it against a standard
  - Analyzing = separating whole entity into its meaningful parts & understanding the interrelationships among those parts
  - Connecting = determining or imposing relationships between the wholes that are being analysed

Creative Thinking (Generated Knowledge)

- Going beyond accepted knowledge to generate new knowledge.
- Major components:
  - Synthesizing = thinking analogically, summarizing in own words, hypothesizing relationships, planning process
  - Imagining = visualize processes, outcomes, possibilities
  - Elaborating on Information = adding personal meaning to information

Three Key Aspects of Creativity

(Cropley, 2001)

1. **Novelty** (a creative product, a course of action or idea necessarily departs from the familiar);

2. **Effectiveness** (it works, it achieves some end);

3. **Ethicality** (the term "creative" is not usually used to describe selfish or destructive behavior, crimes, warmongering etc).

Dynamic Relationships:
Critical & Creative Thinking

- **Critical Thinking** (Judgement Phase)
  - Makes sense out of information using more objective skills, analysis of existing knowledge
    - E.g. analyzing & evaluating information using established external criteria
- **Creative Thinking** (Production Phase)
    - Uses more personal and subjective skills in the creation of new knowledge (not analysis of existing knowledge).
    - However, new knowledge may also be analyzed using critical thinking skills.