Memory, Learning and Production

Presented by

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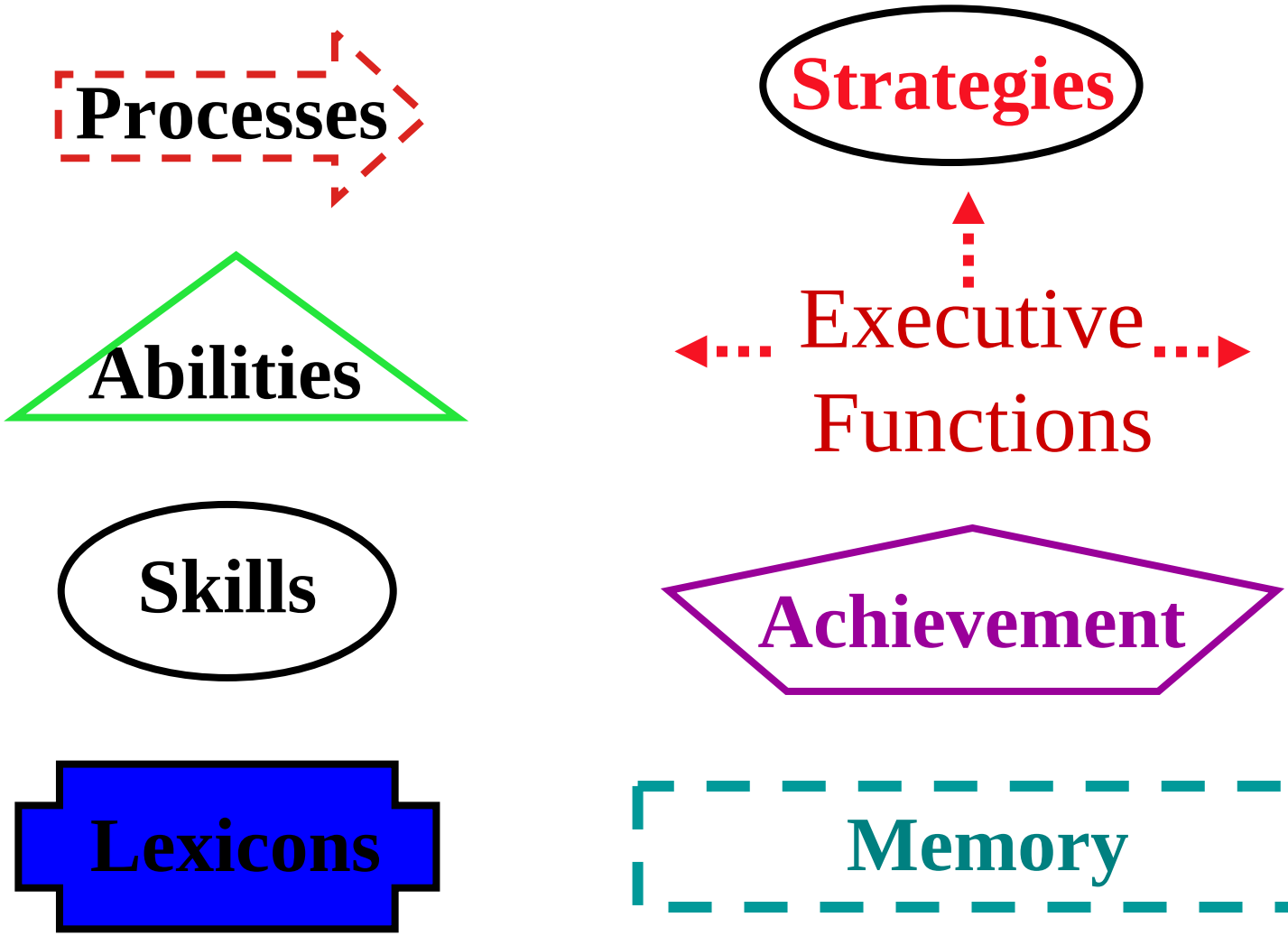
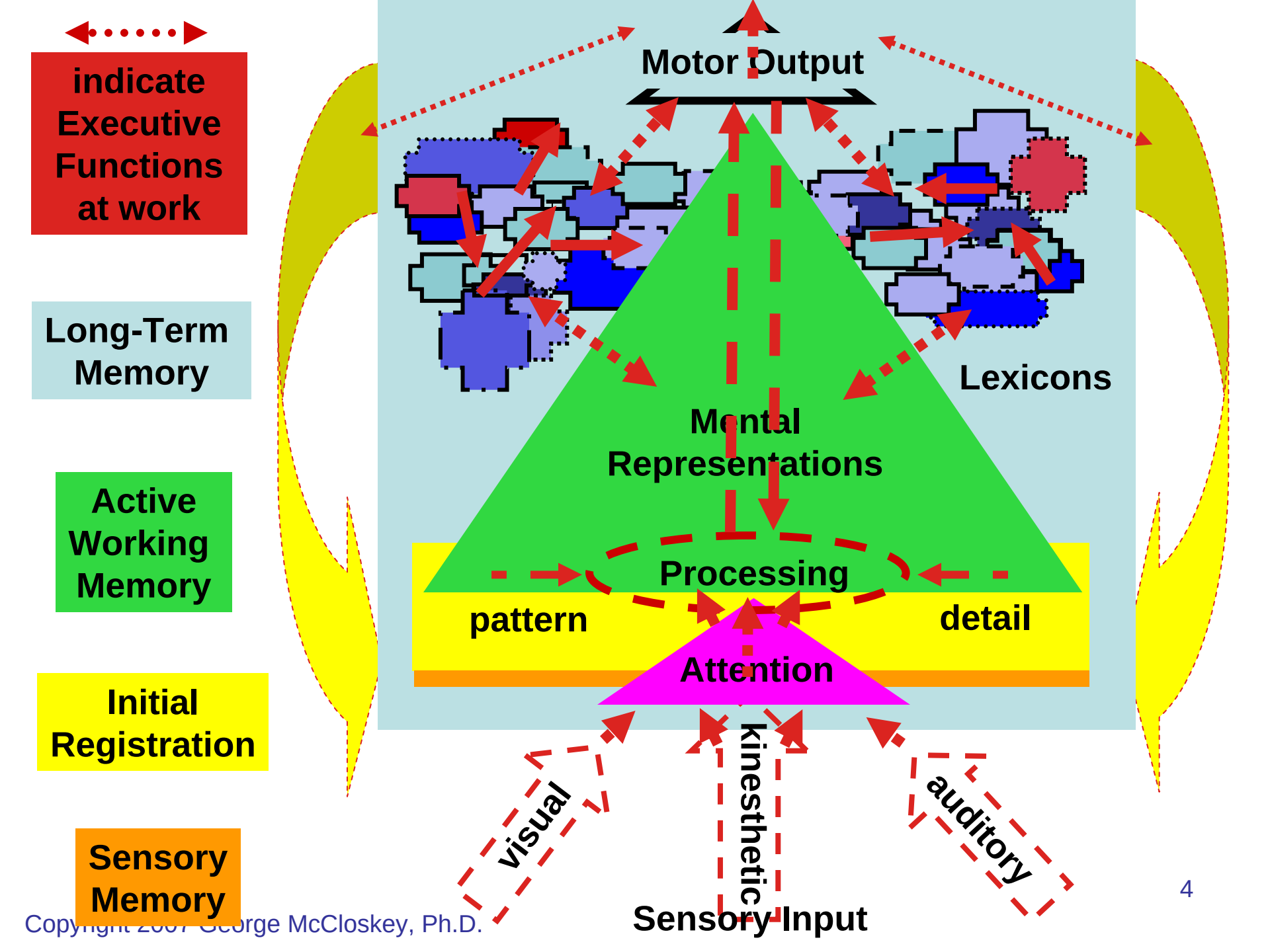
What is Memory?

- Is memory a cognitive process?
- Is memory an ability?

Basic Information Processing Concepts



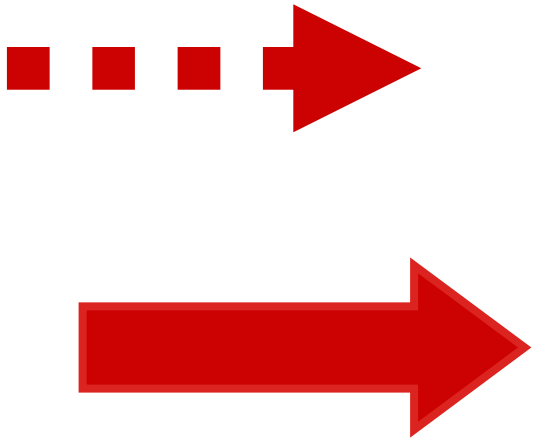


Basic Cognitive Processes

- Basic Cognitive Processes are the cognitive capacities used to translate sensory information and perceptions into internal mental representations

Defining Processes

- Processes include:
  - Auditory Perception
  - Auditory Discrimination
  - Auditory Attention
  - Visual Perception
  - Visual Discrimination
  - Visual Attention
  - Kinesthetic Perception
  - Kinesthetic Discrimination
  - Kinesthetic Attention

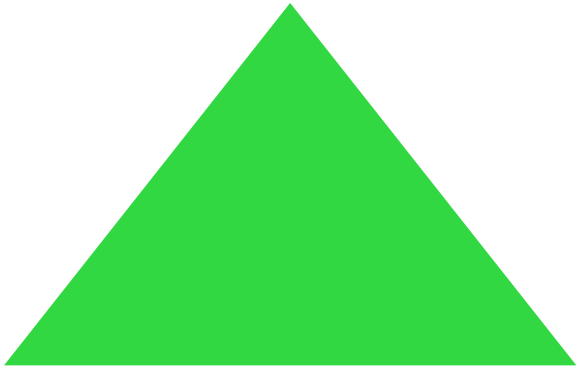


Cognitive Abilities

- Cognitive Abilities are the mental capacities that utilize internal mental representations to produce thoughts and actions; they can be used in a conscious or nonconscious manner.

Defining Abilities

- Abilities include:
  - Visuospatial
  - Motor
  - Language
  - Reasoning/Association
  - Ideation/Generation



Processes vs Abilities

- Processes and Abilities both refer to mental capacities that enable learning and production
- Processes are narrower, more specific mental capacities; Abilities are broader, more overarching mental capacities

Ability Deficits

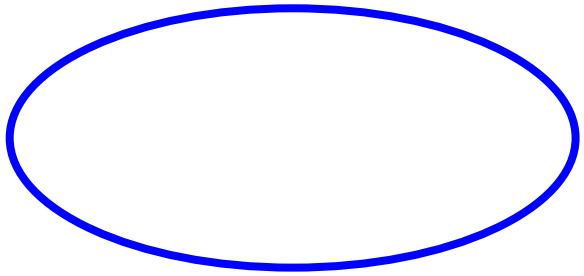
- Ability deficits constrain learning and production; the degree of deficit places an upper limit on learning and production; compensatory or by-pass strategies typically are not very effective in countering ability deficits
- Severe ability deficits result in cognitive impairments, that greatly constrain learning and production, such as severe language impairment or mental retardation

Process Deficits

- Process deficits obstruct learning and production, but often can be by-passed or compensated for at least to some degree; in some instances their effects can be significantly reduced if addressed during early developmental stages with a good intervention program
- Severe process deficits result in learning disabilities and/or producing disabilities involving slowed and/or inconsistent learning and production

Defining Skills

- Skills are specific, learned routines; skills are utilized in concert with abilities, processes, lexicons and strategies to perform tasks or increase the knowledge store through new learning

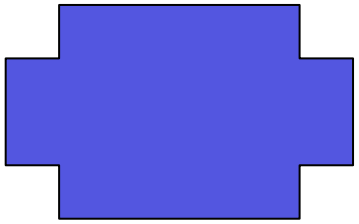


Defining Lexicons

- Lexicons are knowledge bases from which information can be retrieved and used to inform learning or production.
- There are numerous subtypes of Lexicons, including:
  - Auditory-Verbal, Auditory Non-Verbal, Visual-Verbal, Visual Non-verbal, Gross Motor, Fine Motor, Graphomotor, Procedural, Verbal Emotional, Non-verbal Emotional, Verbal Social, Non-verbal Social.

Defining Lexicons

- Lexicons also vary based on the manner in which the information was registered:
  - Explicit episodic (event-related; what, when where)
  - Explicit declarative (semantic and nonsemantic consciously stored information)
  - Implicit procedural (nonconscious and/or automated routines)
  - Implicit reflexive (conditioned responses; intense emotional experiences)



What are Executive Functions?

- Executive Functions are a specific class of processes distinct from the basic processes used to transform sensory information into internal mental representations
- Executive Functions cue, direct, and coordinate the use of all other mental capacities

Defining Strategies

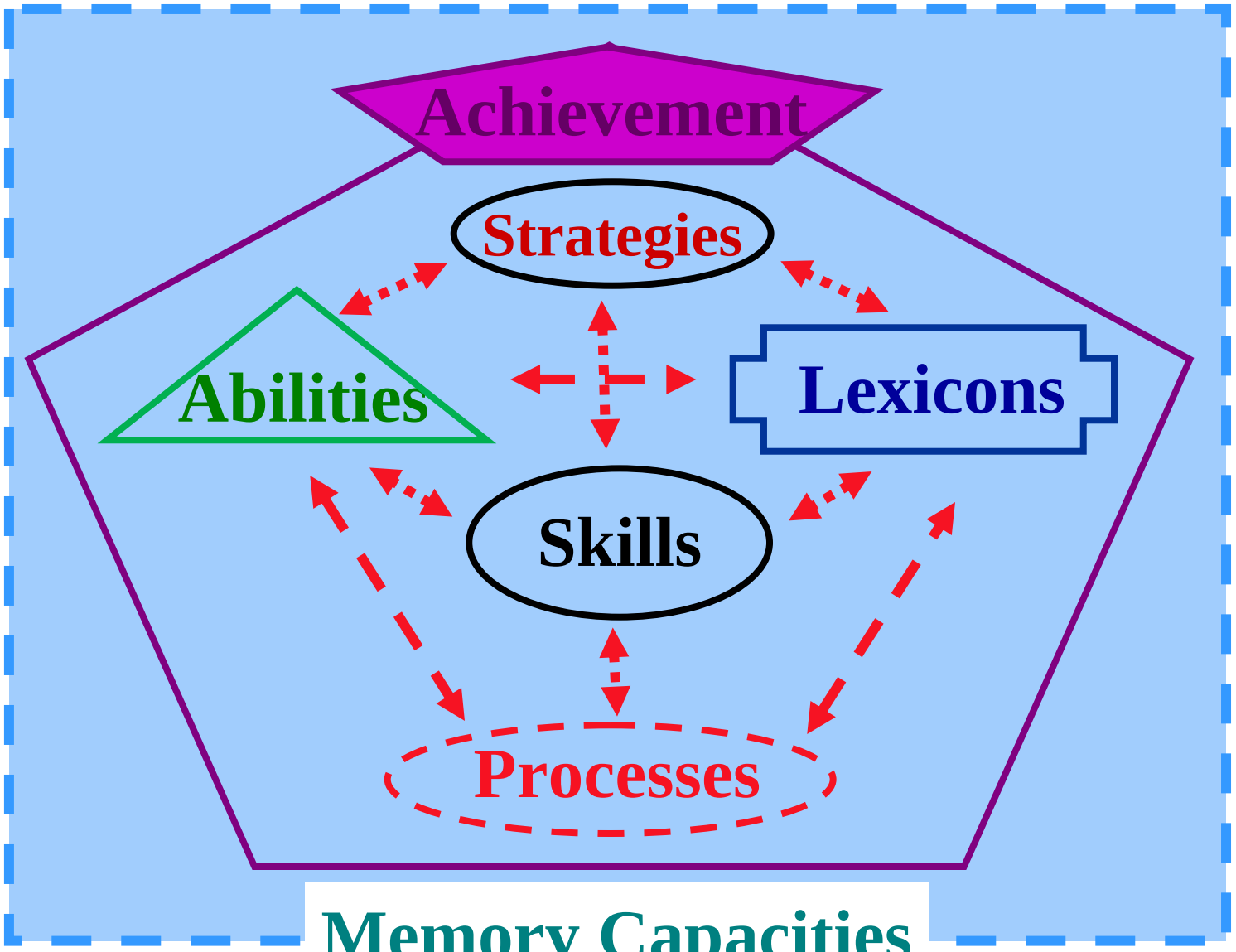
- Strategies are more general learned or newly generated routines that can be applied to increase the efficiency of the use of abilities, processes and/or skills

Defining Achievement

- Achievement is the end result (product) of the application of abilities, processes, skills and strategies to a contextually meaningful task

What is Memory?

- Memory capacities are distinct from processes, abilities, lexicons, skills, strategies and achievement; they are the essential mental manifestation of time and space, i.e., they provide the temporal and spatial contexts for perception, emotion, cognition, and action.

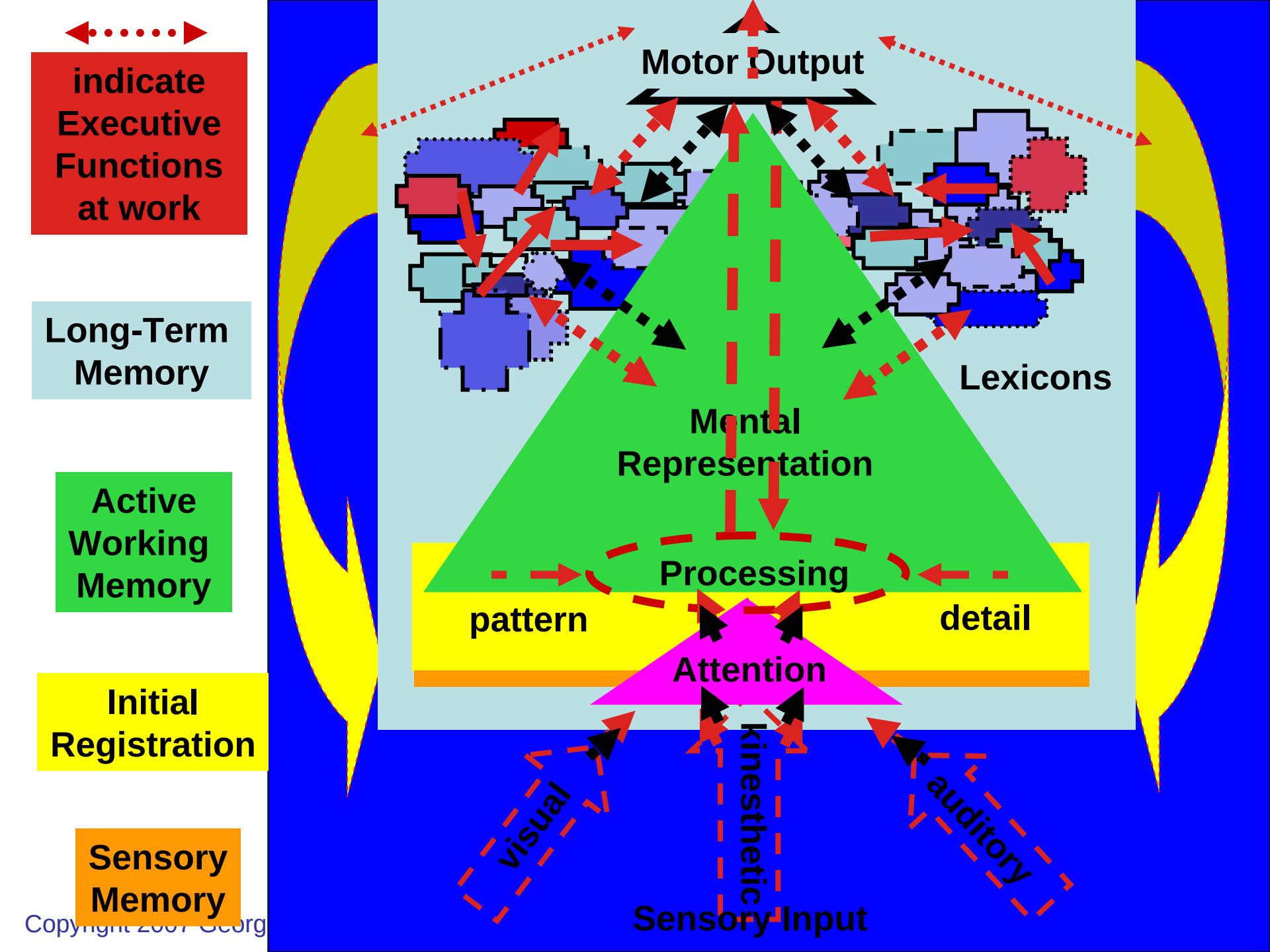

Achievement
Strategies
Abilities
Lexicons
Skills
Processes
Memory Capacities

Memory vs Abilities and Processes

- Memory capacities are similar to abilities in that they are broader and more overarching in their impact on learning and production
- Memory capacities are similar to processes in that while they obstruct learning and production; they often can be by-passed or compensated for at least to some degree.

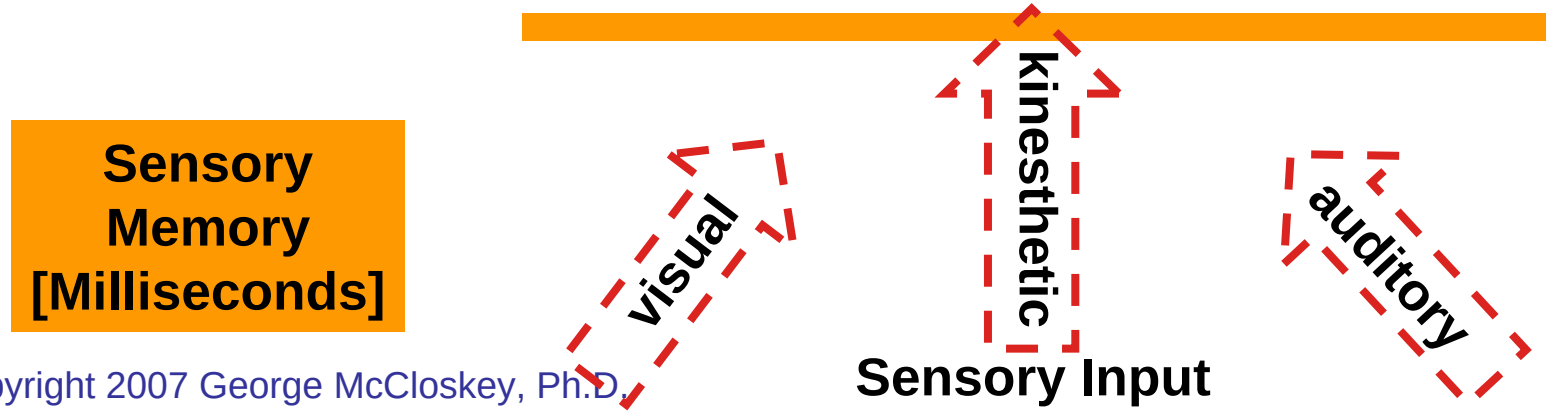
Temporal Frames of Reference

- **Four Primary Temporal Contexts:**
  - **Sensory Trace** (milliseconds in duration; preconscious instantaneous sense of “what is”)
  - **Initial Registration** (1-10 seconds; immediate sense of “what is” now)
  - **Active Working Memory** (seconds to minutes; usually less than a minute; extended sense of now that becomes a sense of the future)
  - **Long Term Memory** (minutes to days; sense of the past, i.e., recollection of “what was” then)



Sensory Trace – What Is

- Provides the time signature during a brief, preconscious registration of stimuli
- Provides a preconscious sense of a present moment
- Extremely fleeting in duration (milliseconds)
- Not involved with conscious processing of mental representations

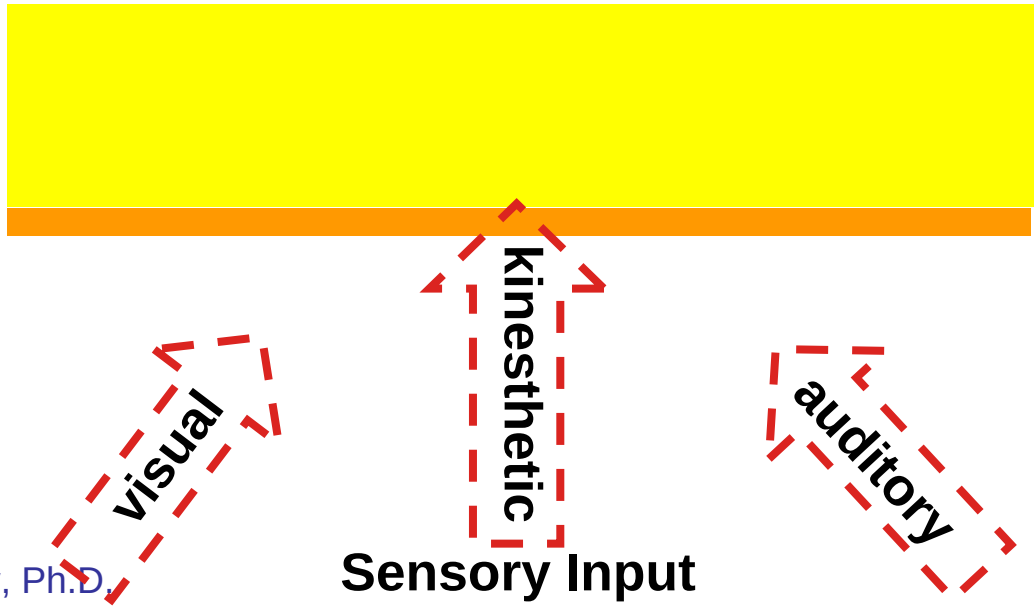


Initial Registration – What is Now

- Provides the time signature for the period spanning the initial awareness of stimuli to the formation of psychologically meaningful mental representations of the stimuli.
- Temporary in nature (a few seconds duration)
- Provides a psychological sense of "now"

Initial Registration [1-9 seconds]

Sensory Memory [Milliseconds]



Variations in the “Now”

- The psychological sense of now has definite time limitations that vary somewhat for each person; initial registration cannot extend beyond the individual’s “now” time window. Depending on the nature of the information being processed “now,” the time signature typically can only be extended to about 10 seconds. Typical time signatures for now are in the millisecond to 2-3 second range.

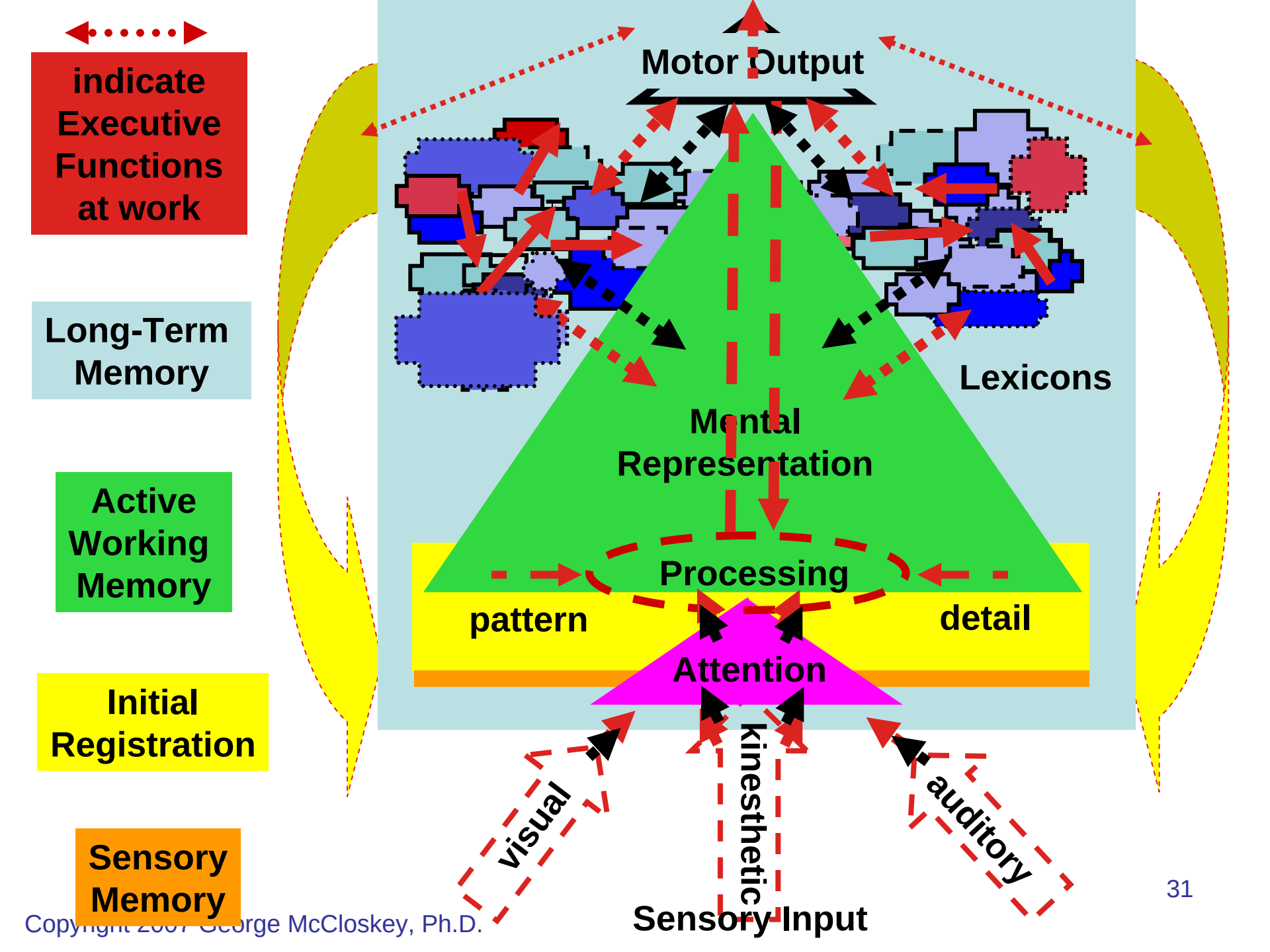
Initial Registration of Visually Presented Information

- PAL Receptive Coding directions:

  I will show you two words one at a time. If the words are exactly the same, say “yes.” If the words are not exactly the same, say “no.”

good

good

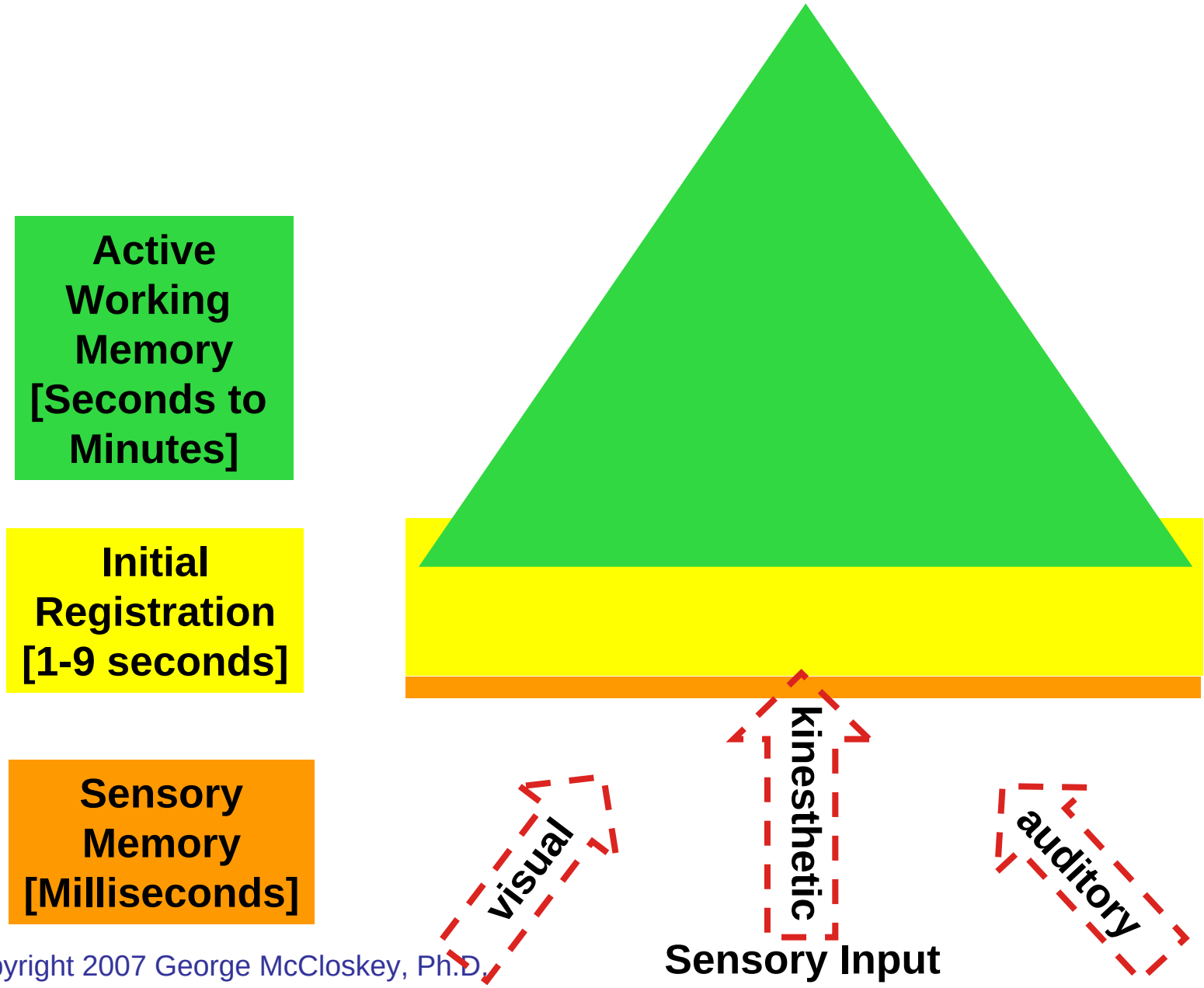


Initial Registration of Auditorilly Presented Information

- WISC-IV Digit Span Forward

Active Working Memory – The Future of Now

- Provides the time signature for the period of active engagement of mental representations- an extended psychological sense of “now”.
- Relatively temporary in nature (typically lasting less than a minute, but can be extended for several minutes or possibly longer).
- Provides the time signature for extending consciousness beyond the present moment for a psychological sense of the future.

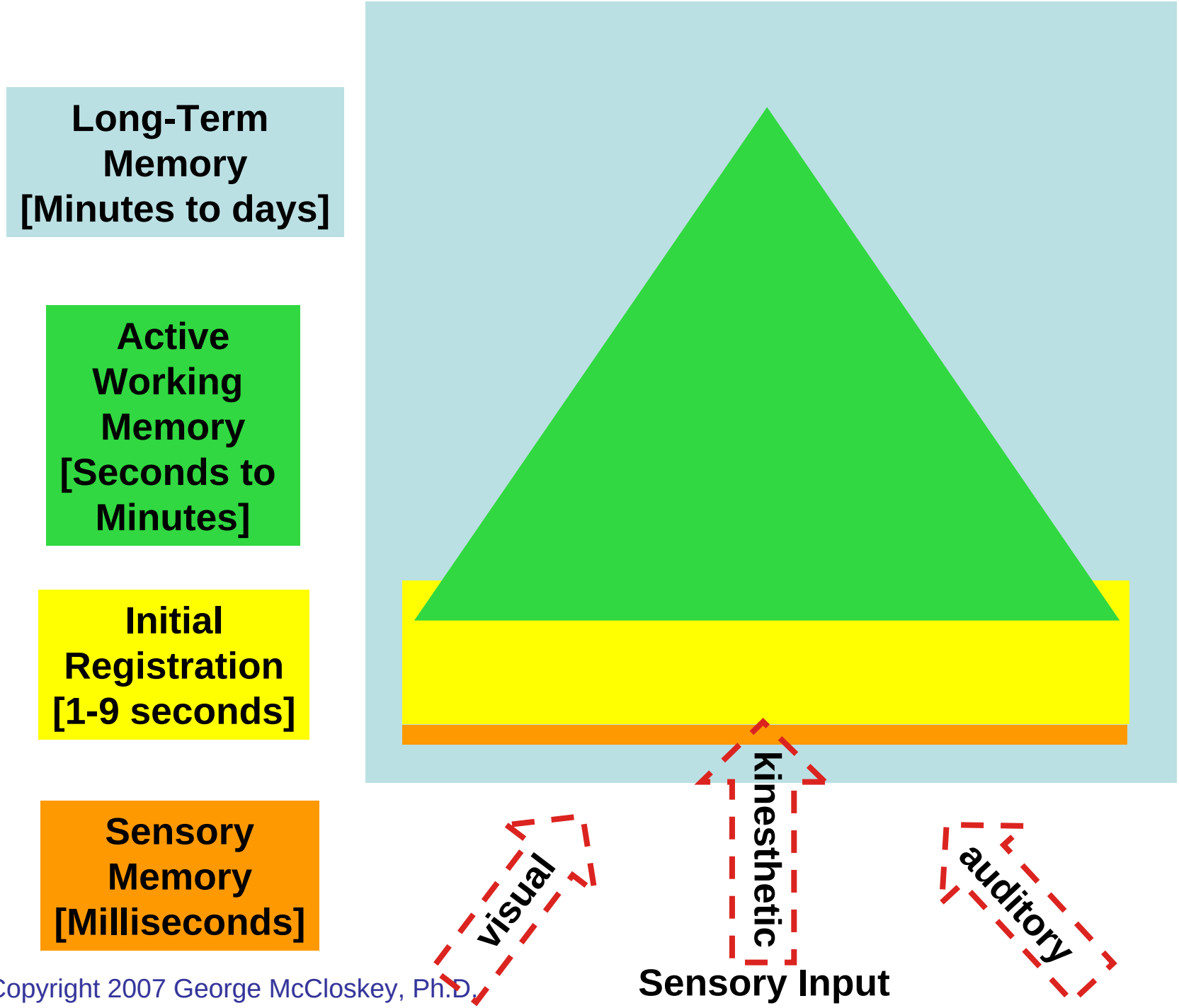


Active Working Memory

- Alternate between saying the letters of the alphabet and the numbers: A1, B2, C3, …
- WISC-IV Digit Span Backward
- WISC-IV Letter-Number Sequencing

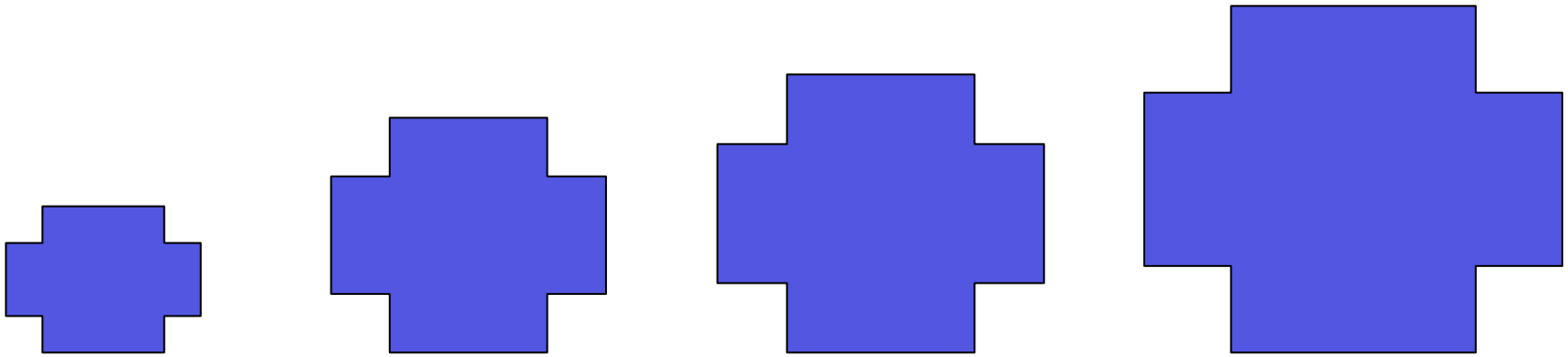
Long Term Signature – What was Then

- Provides the time signature for a psychological sense of the past; picks up where the sense of “now” leaves off (from minutes to days, months, years)
- Recently tagged information (2-3 minutes to 2-3 days in duration) is more vulnerable to loss of access than information tagged further in the past (days to years)
- Responsible for the psychological experience of “re-calling or re-membering the past”



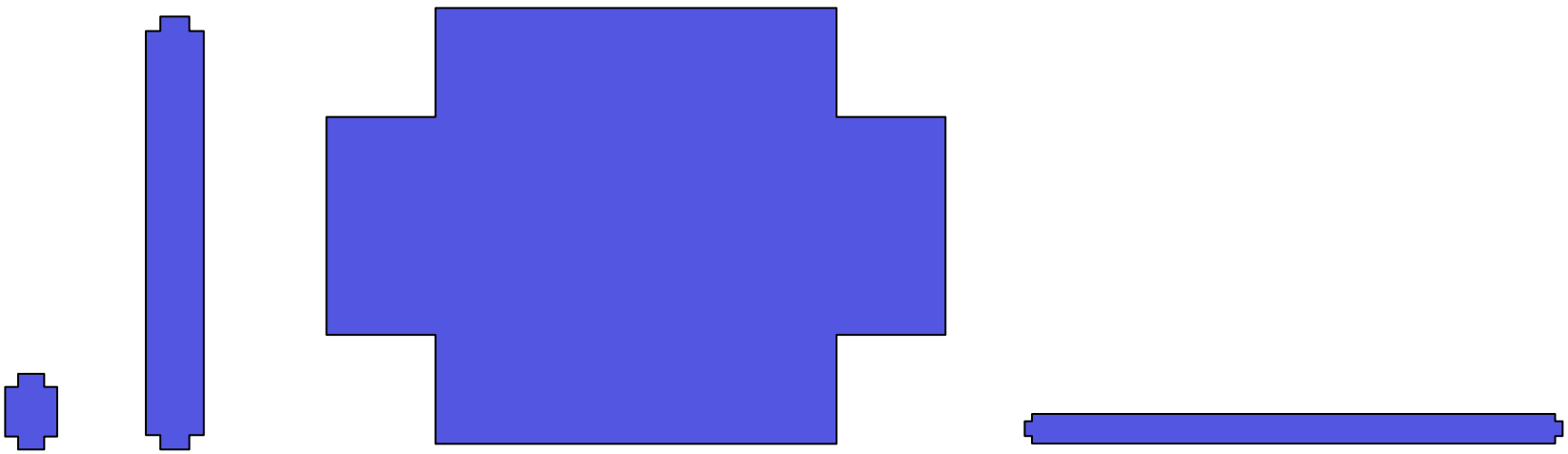
Lexicons Populate the Long Term Store

- Lexicons are knowledge stores that can vary in size, i.e., in amount of stored information;



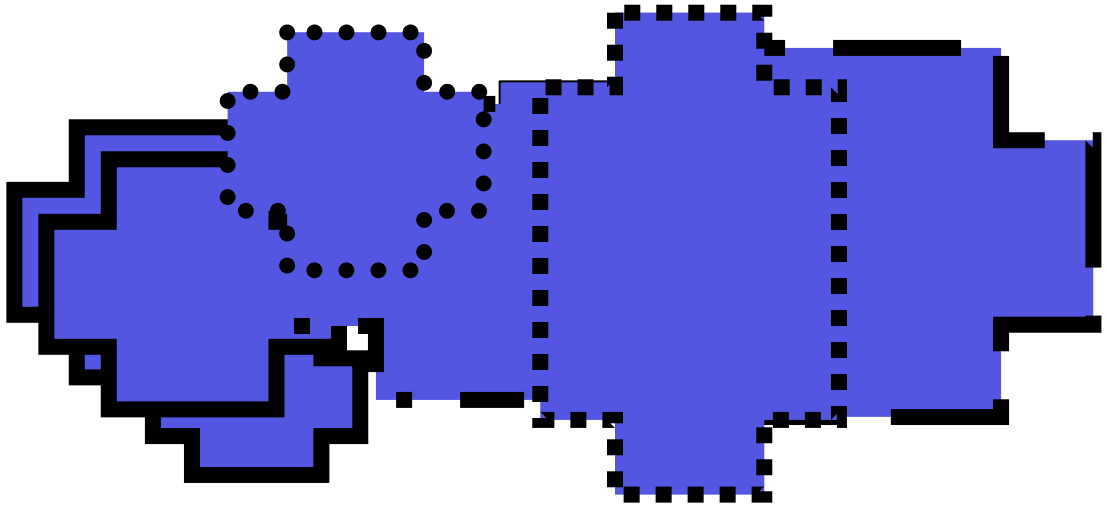
Lexicons

- Lexicons can vary in breadth and depth, i.e., a lexicon can represent a very broad or a very narrow, a very deep or a very shallow, body of accumulated knowledge.



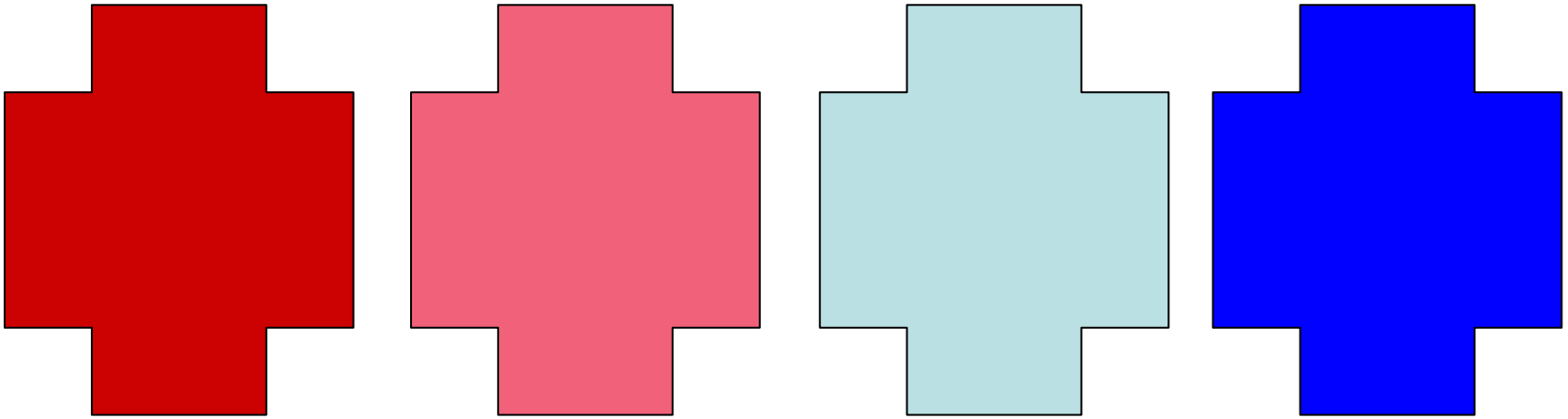
Lexicons

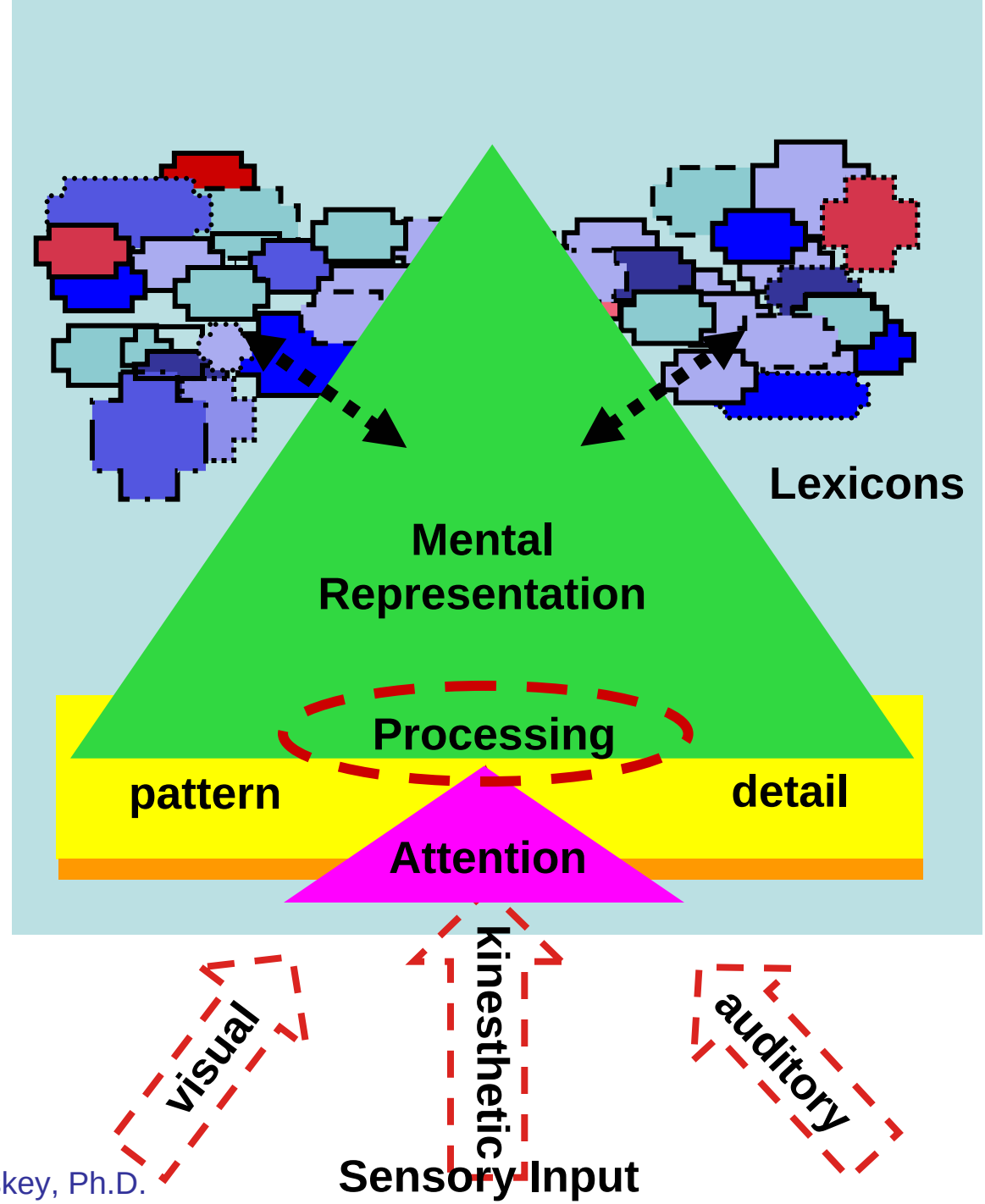
- Lexicons can vary in terms of accessibility and frequency of use; some are easier to access than others; some are accessed more frequently than others.



Lexicons

- Lexicons can vary in terms of emotional tone and intensity.



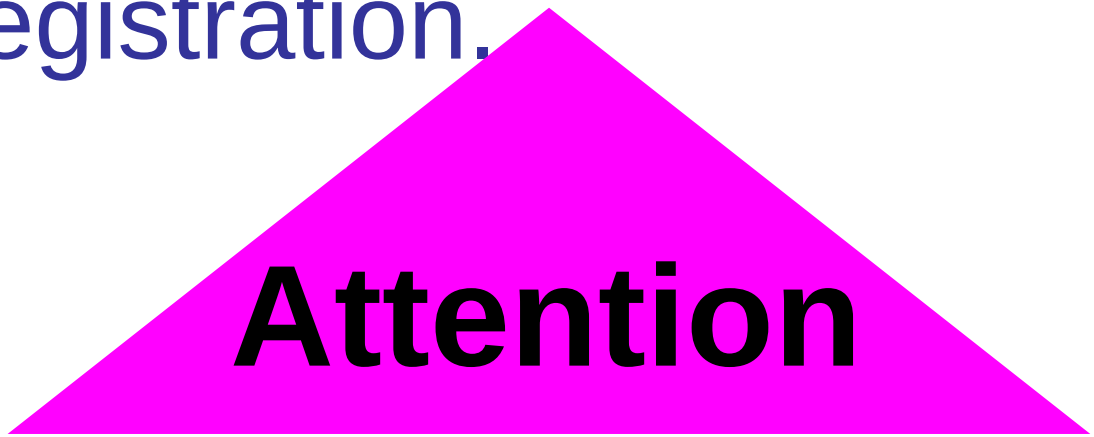


Temporal Contexts for Memory

- These four temporal contexts provide the backdrop on which the processing of information occurs (the use of abilities, processes, skills, strategies, and lexicons)

The Role of Attention During Initial Registration

- Adequate attention capacity and adequate focusing of that attention capacity is necessary for effective conscious processing of input during initial registration.



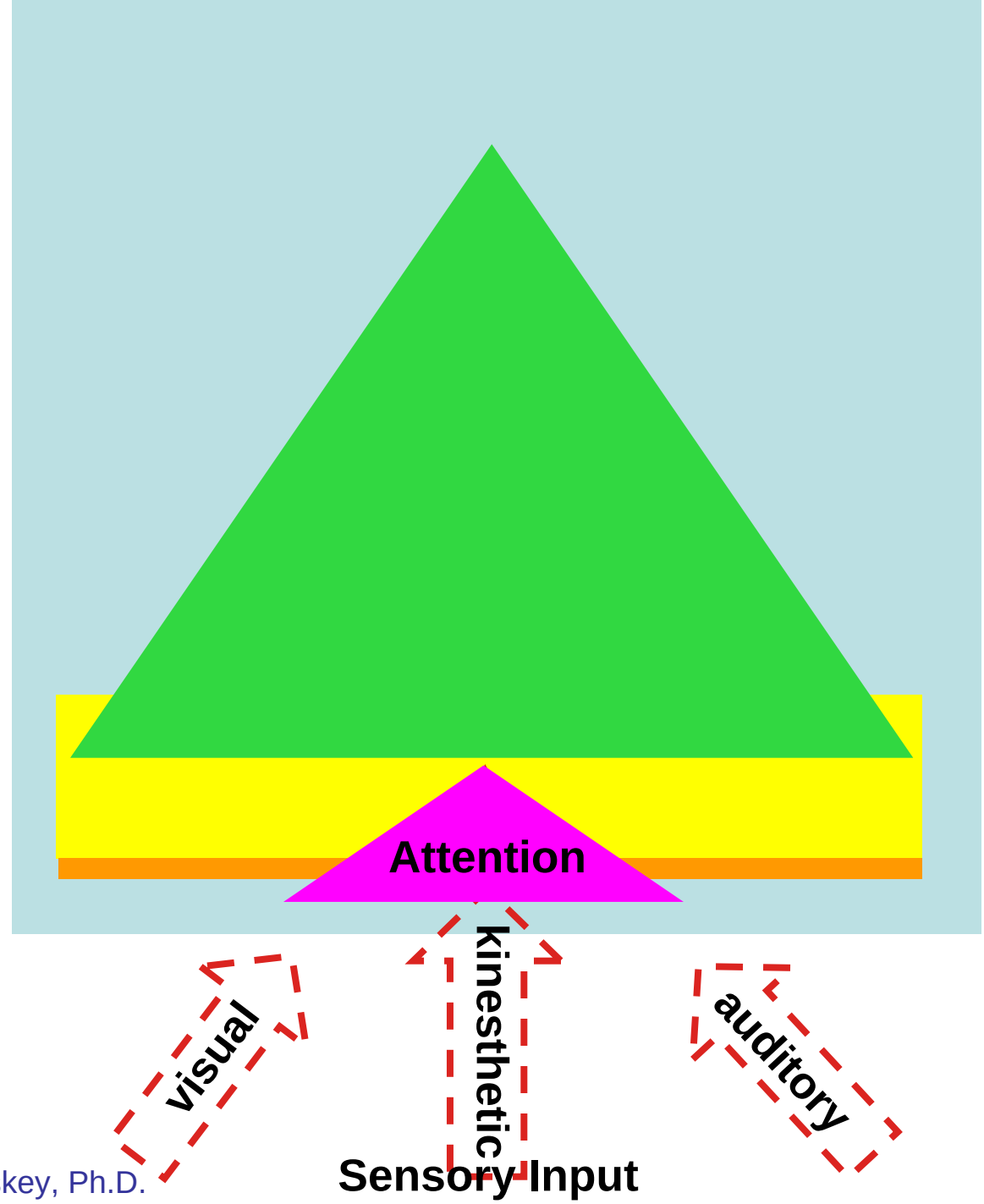
indicate Executive Functions at work

Long-Term Memory

Active Working Memory

Initial Registration

Sensory Memory



The Role of Processes

- Processes are applied (the act of processing) during initial registration to translate sensory input into perceptions that form mental representations.

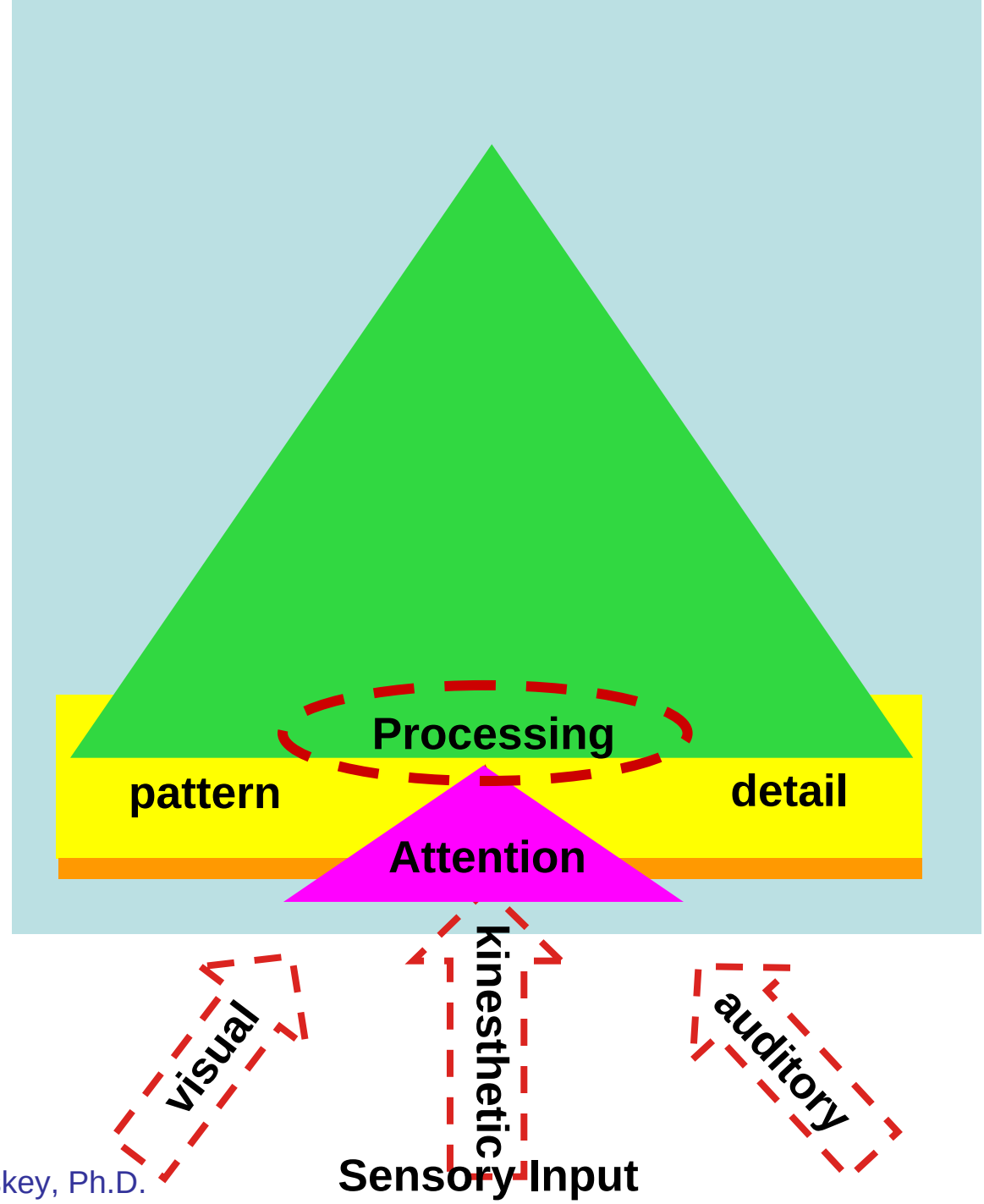
indicate Executive Functions at work

Long-Term Memory

Active Working Memory

Initial Registration

Sensory Memory



Visual Processing During Initial Registration

- Nonverbal Visual Processing (i.e., Non-orthographic visual processing)
- Verbal Visual Processing (i.e., Orthographic visual processing)

Non-orthographic Visual Processing

Perception of this image varies depending on whether you are engaging pattern-oriented perceptual processes or detail-oriented perceptual processes. Patter-oriented processing leads to perceiving the visual image of a young girl. Detail-oriented processing leads to perceiving the visual image of an old woman. Many viewers can consciously or nonconsciously alter the perception process at will, first seeing a young girl, then an old woman or vice versa.

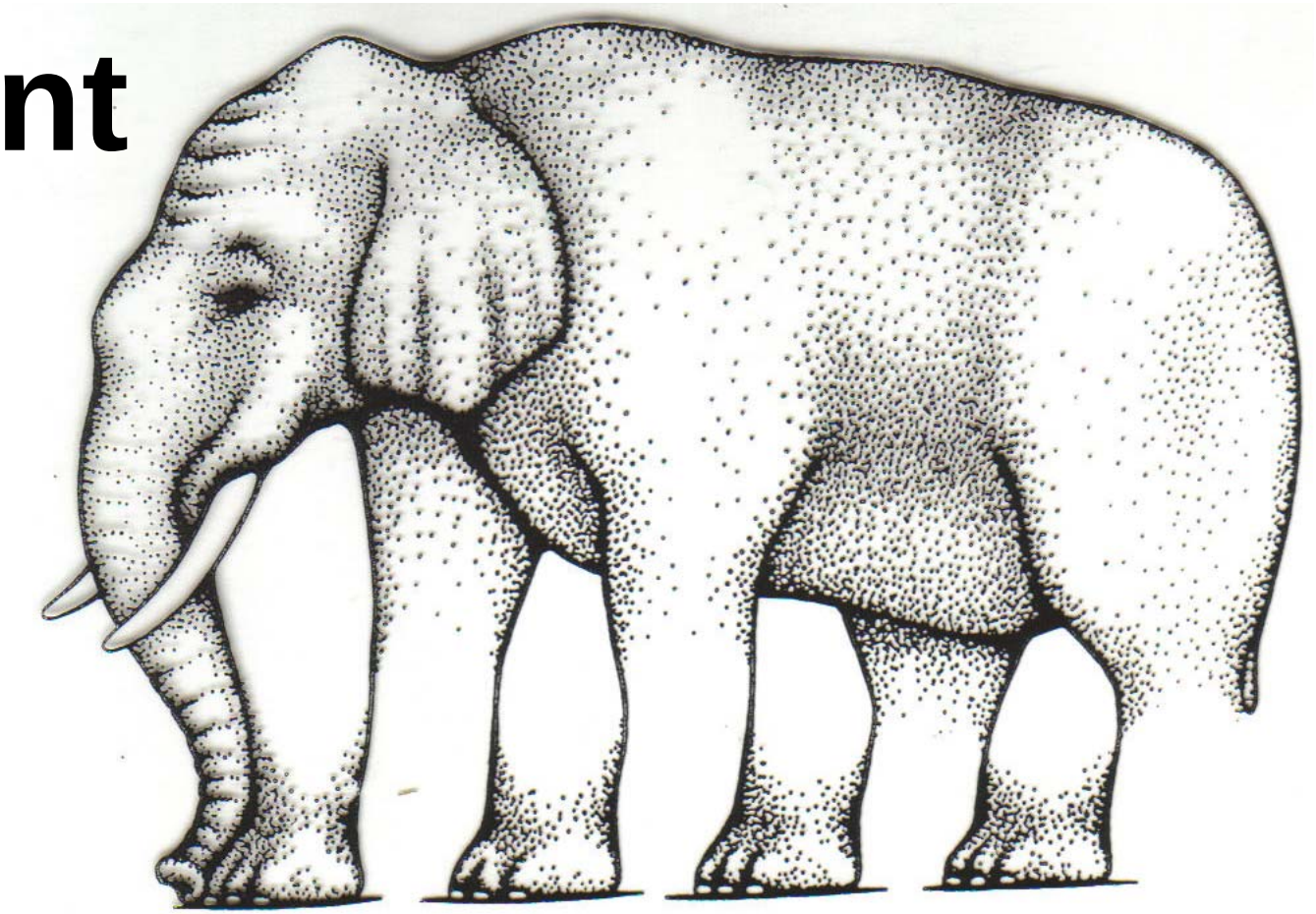
Non-orthographic Visual Processing

Visual Processing

Orthographic

elephant

Non-orthographic



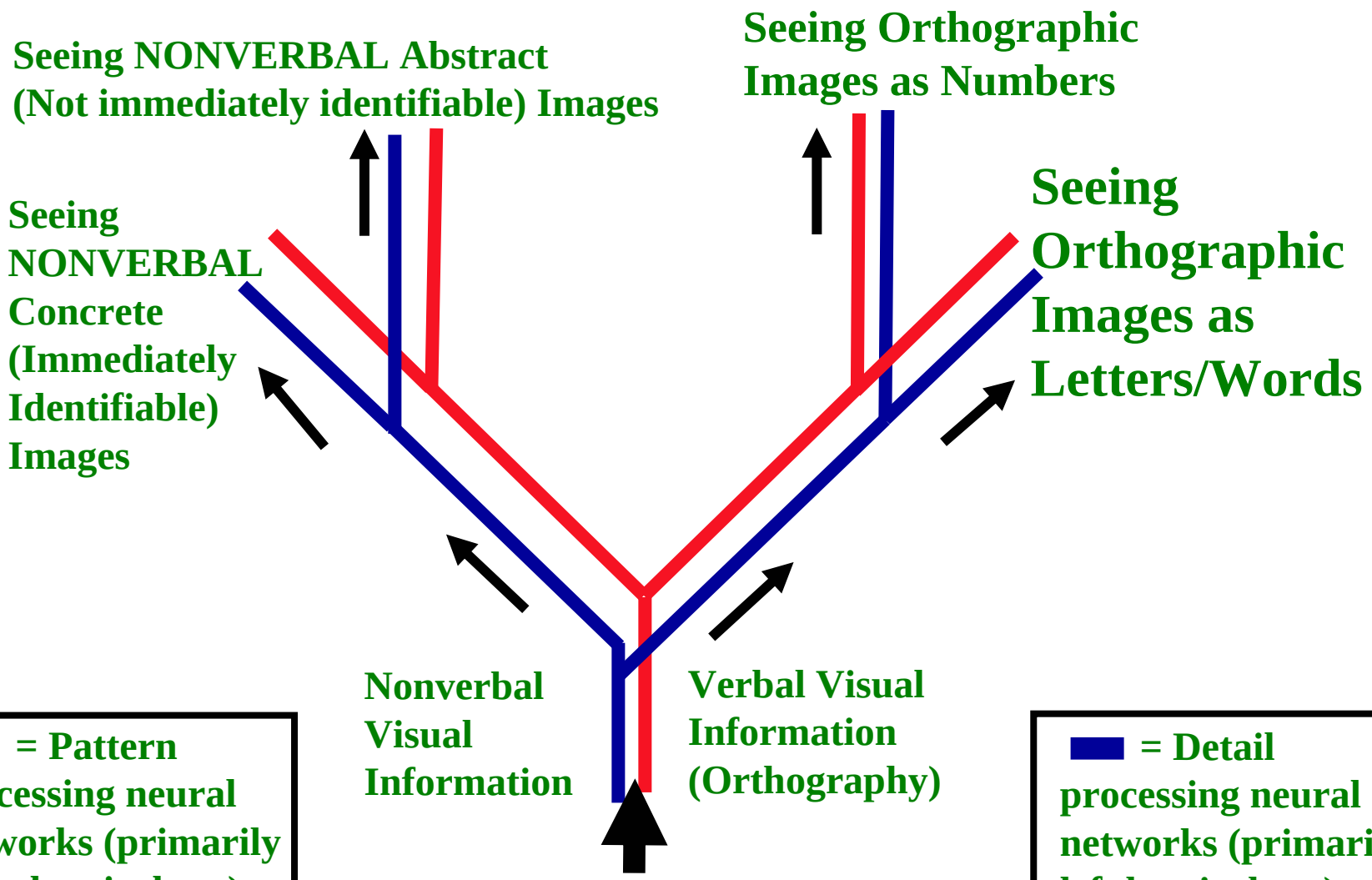
Orthographic Processing

bread

beard

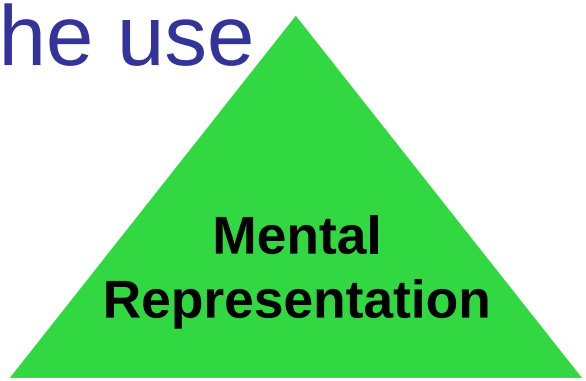
When viewing orthography, detail processing should be the preferred mode for visual processing rather than pattern processing. Although pattern processing can easily distinguish between “rea” and “ear” because the outer contours are different, pattern processing cannot distinguish “bread” from “beard” because the outer contours are the same. Good readers perceive all of the details of every word, thereby avoiding perceptual errors when reading similar words.

Visual Information Processing Neural Networks



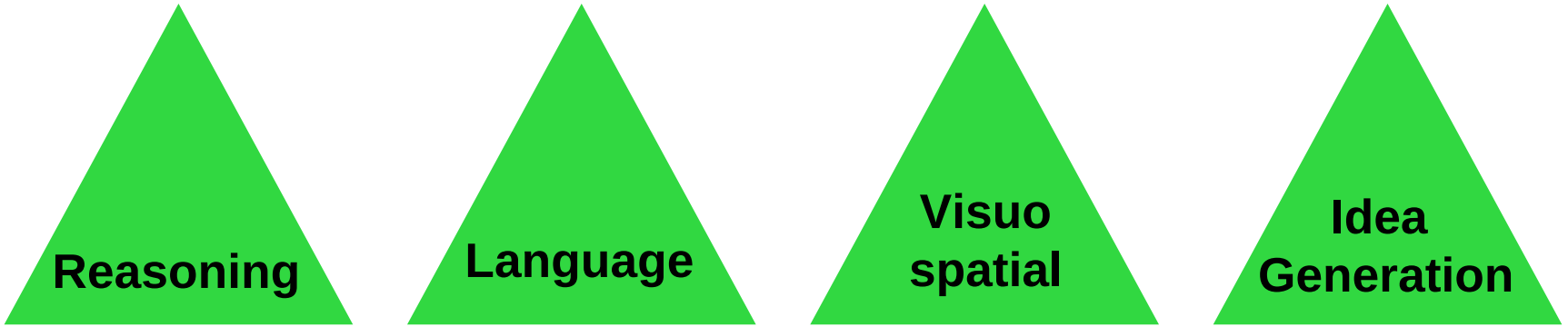
Mental Representation During Activation of Working Memory

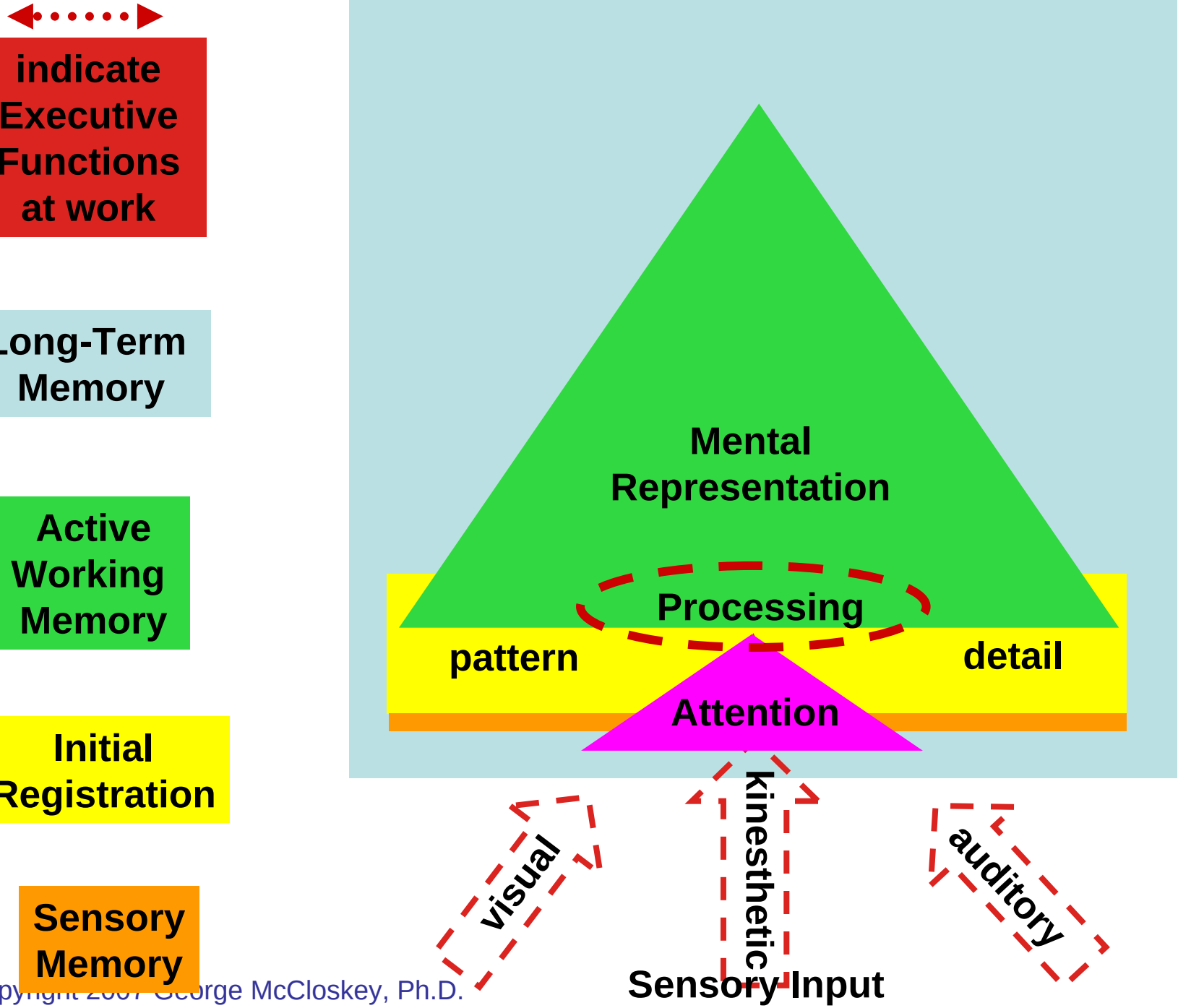
- The active working memory time signature is applied to information that is being represented in mind (mental representations). This active workspace can consist of information being held beyond the initial registration time signature and/or information that is retrieved from one or more lexicons and/or internal feedback from the use of motor abilities.



Abilities in Mental Representation

- Abilities carry an active working memory time signature and are engaged to manipulate the information being mentally represented within the work space.





Initial Registration and Active Working Memory

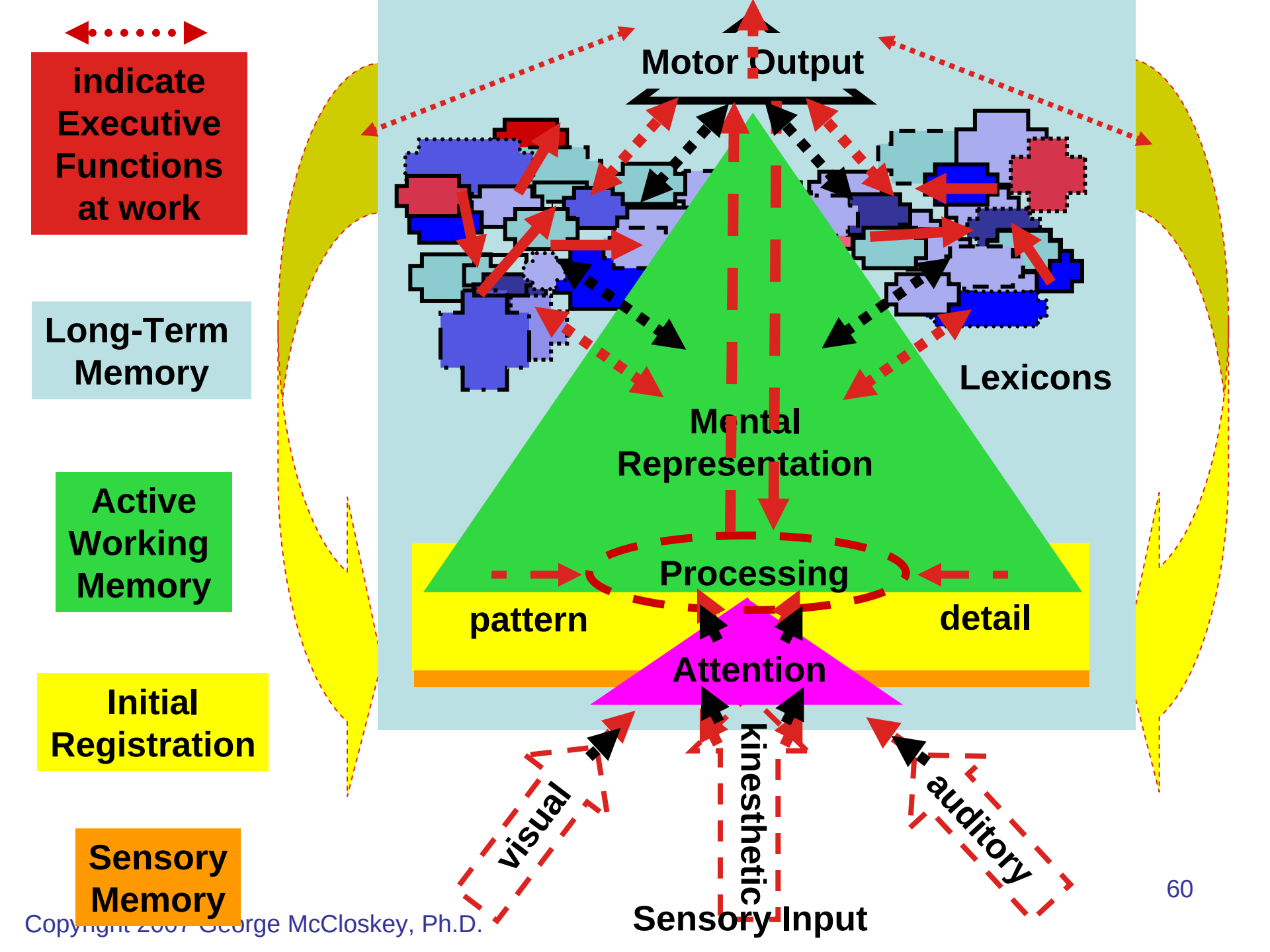
- Demands for manipulating information that is initially registered necessitates the use of active working memory to extend the “now” time signature.
- Examples: Mental Arithmetic

WISC-IV Arithmetic

Kim is watching 8 birds on the ground. Four birds fly away. Two other birds land. How many birds is she watching now?

WISC-IV Arithmetic

Rose bought 3 comic books for 2 dollars each and a toy for 7 dollars. How much change would she get back from a 20-dollar bill.

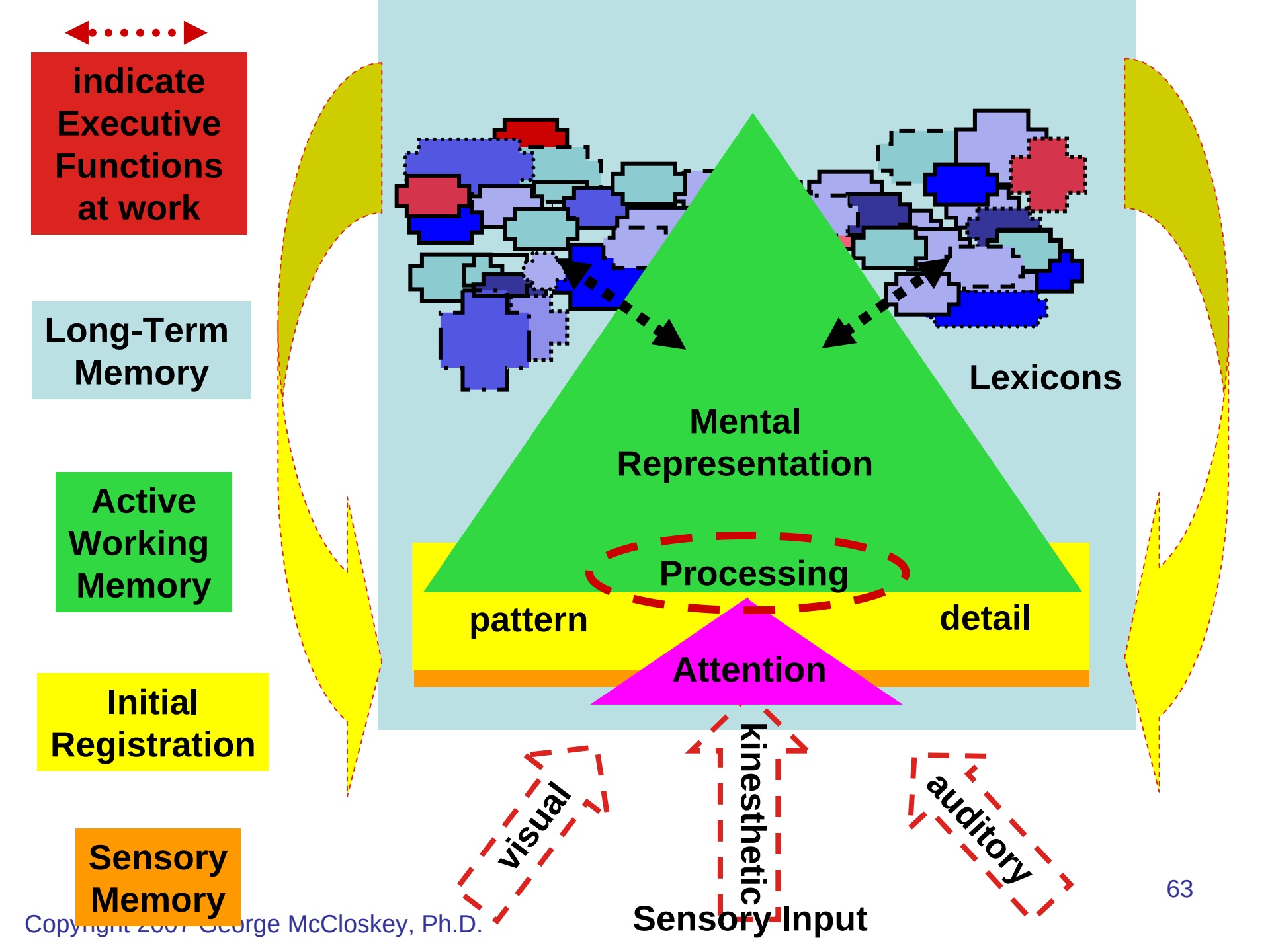


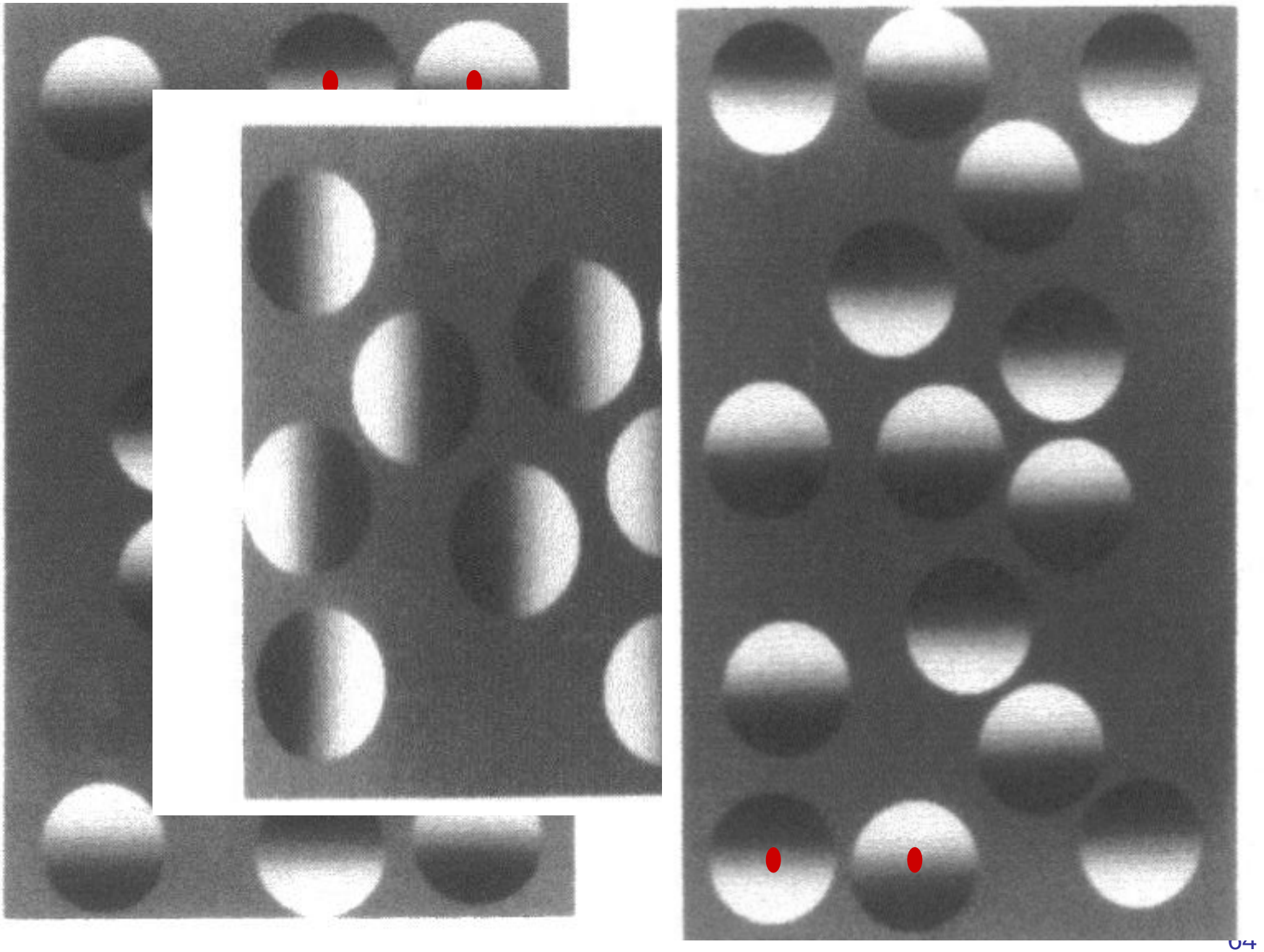
“Now” Relies on “Then”

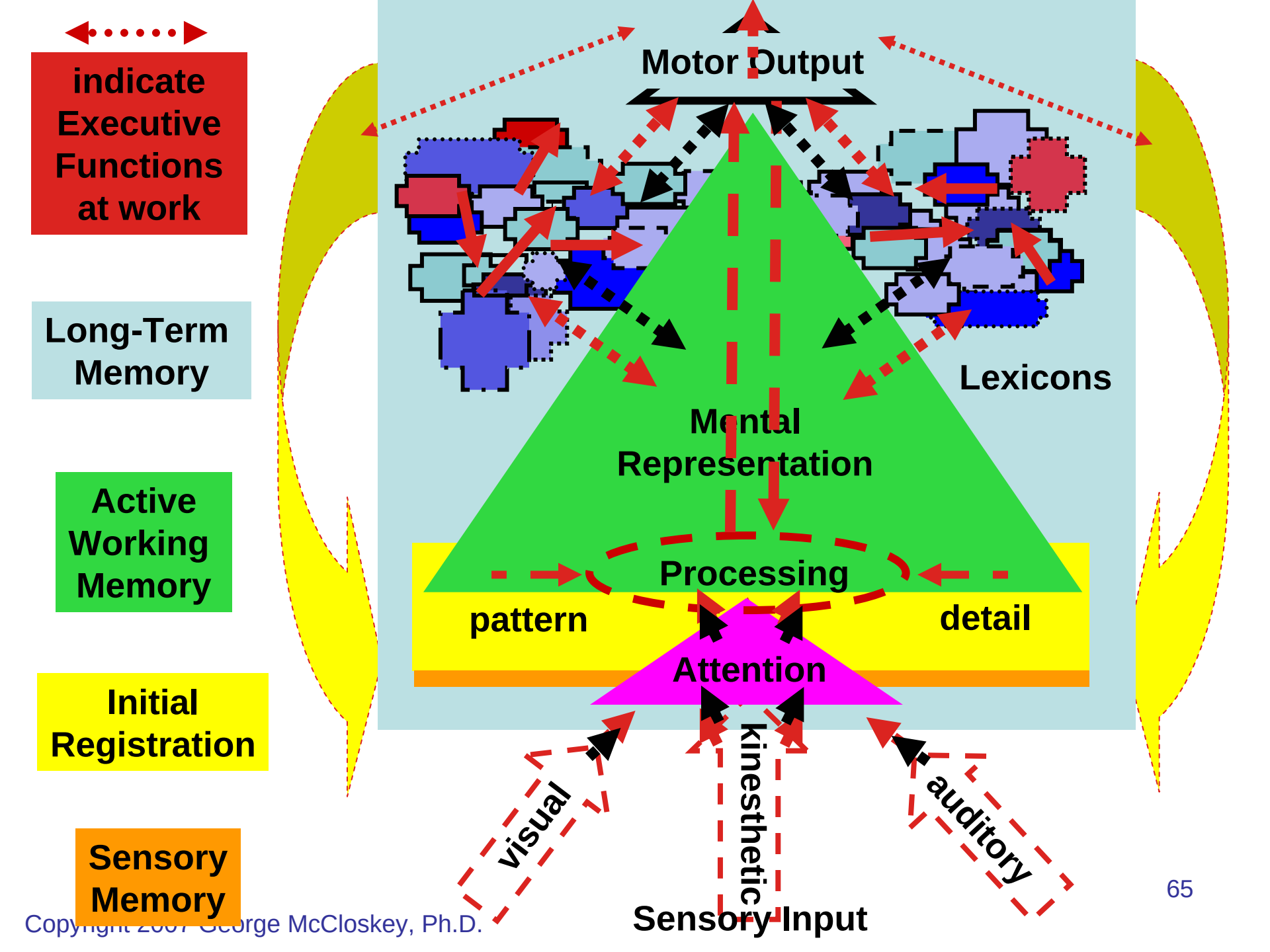
- Almost all initial registration in the “now” moment requires access of previously stored information. Overreliance on previously stored information to process information in the “now” moment of initial registration can cause misperceptions. Conversely, inaccessibility of previous information can cause misperceptions.

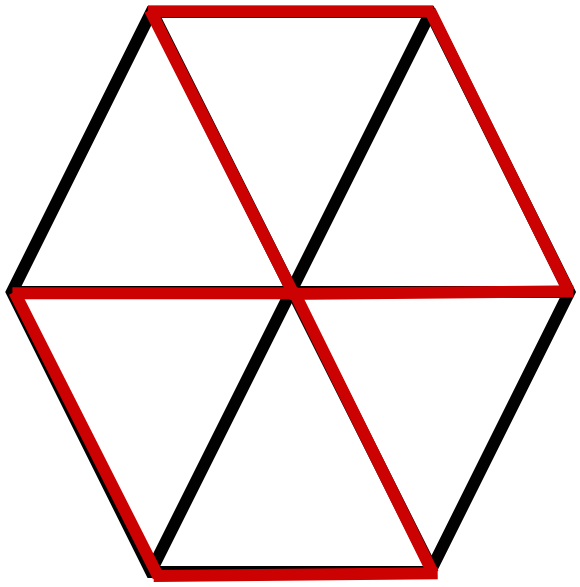
Lexicons

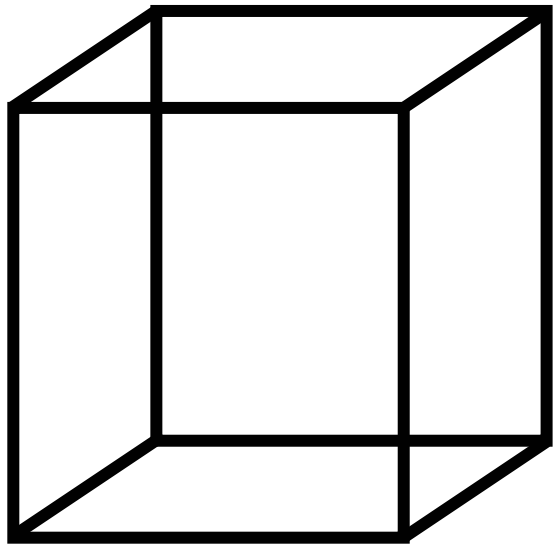
- Lexicons influence perception; the greater the perceptual knowledge base, the greater the influence of Lexicons on perception.











Auditory Processing During Initial Registration

- Examples from phone messages and radio broadcasts:

Sabeha Sadiq

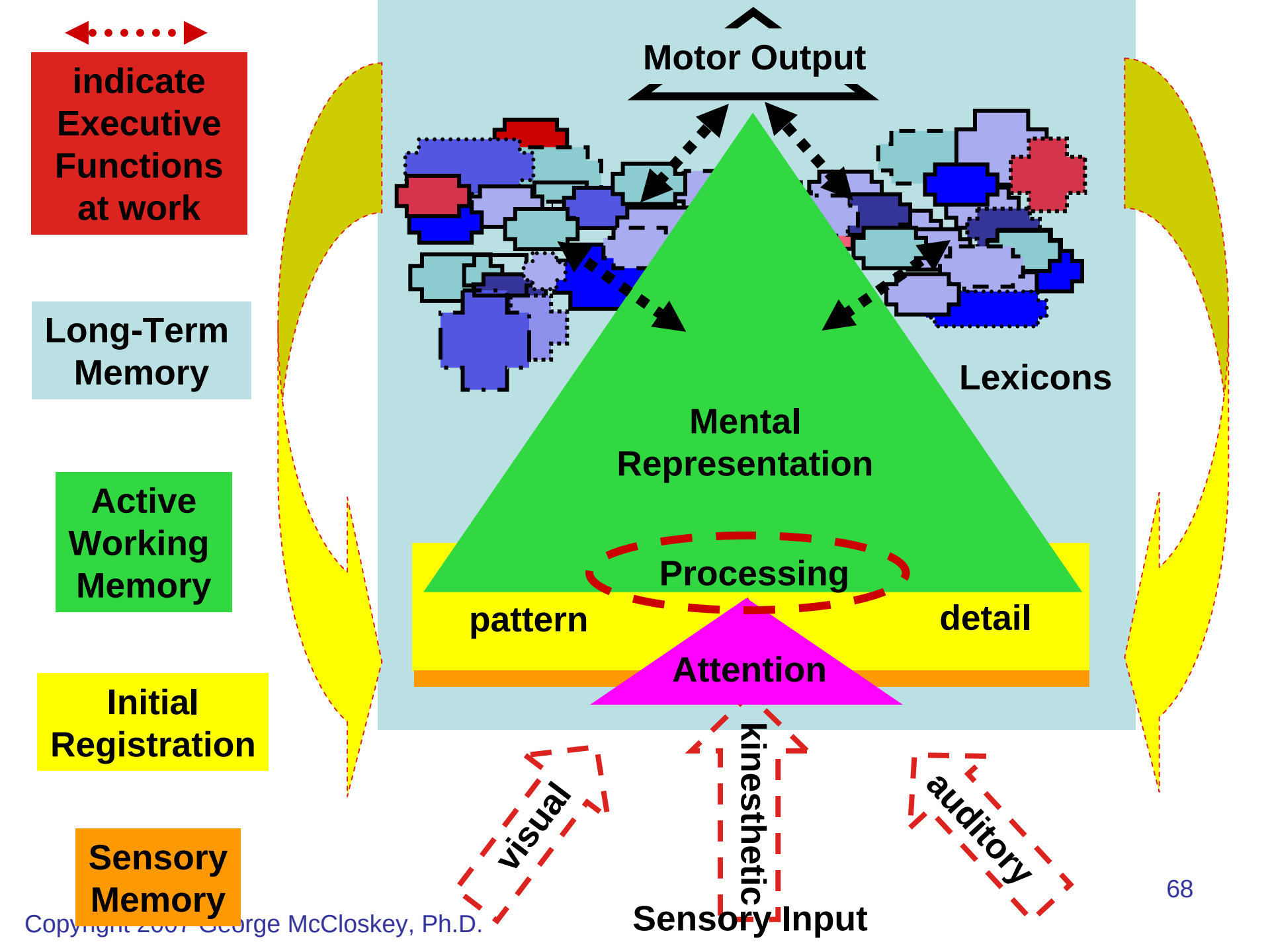
Morag Christie-Churn

Snik Daperkash Snikda Perkash

Snikdaper Kash

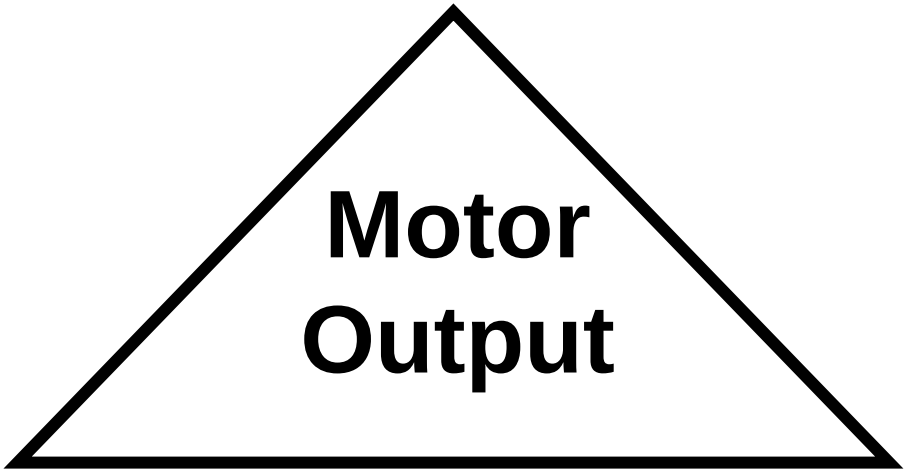
Your in Town Urinetown

Morristown Moorestown



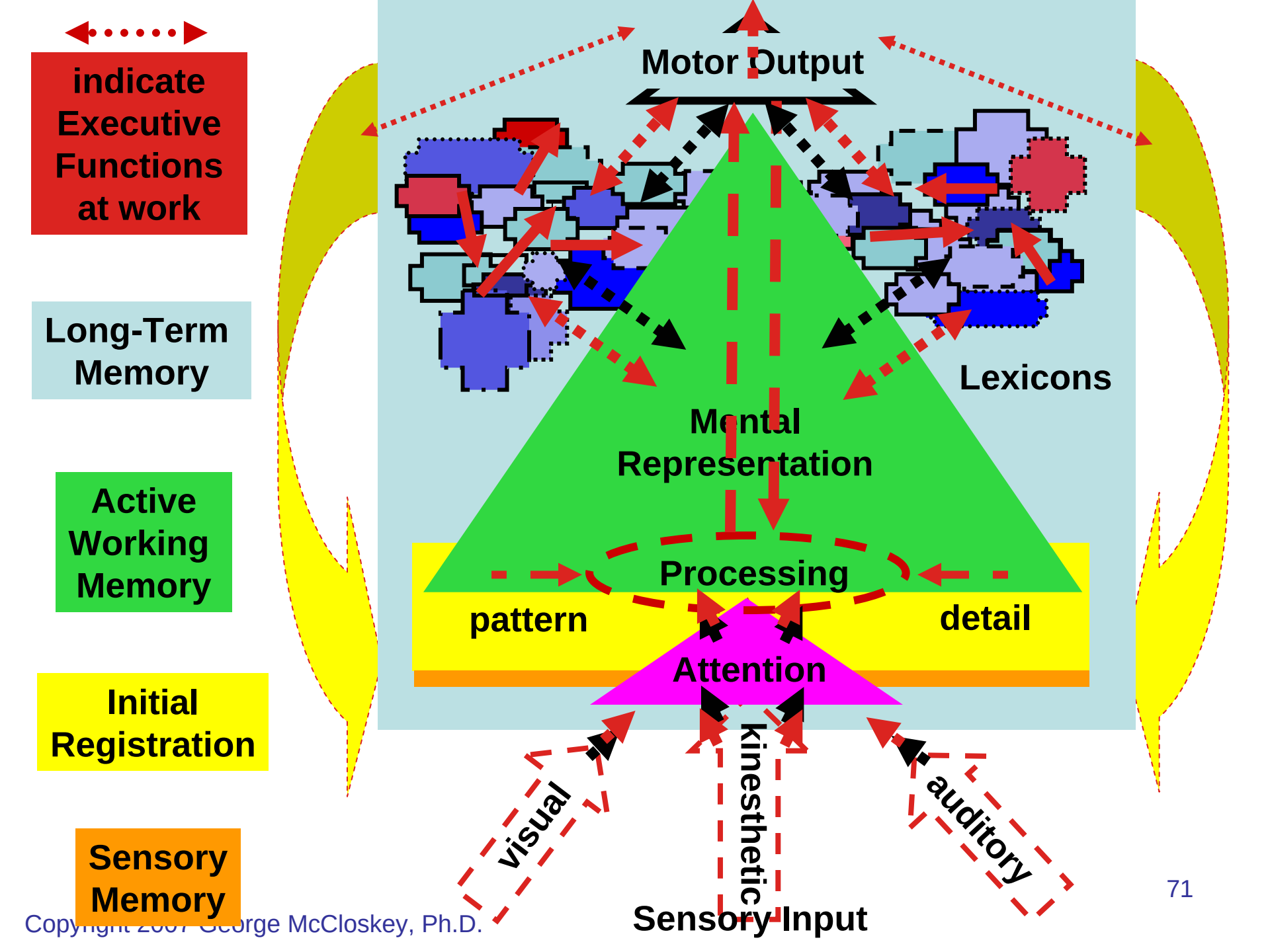
Motor Output

- Motor output represents the use of gross and fine motor abilities to carry out routine tasks (nonconscious action) or to translate thought into production (conscious action).



Executive Functions

- Executive Function processes cue, direct, and coordinate the use of (other) processes, abilities, skills, lexicons, and strategies in learning and production.
- Executive Functions cue and direct processing in relation to perception, emotion, cognition, and action.



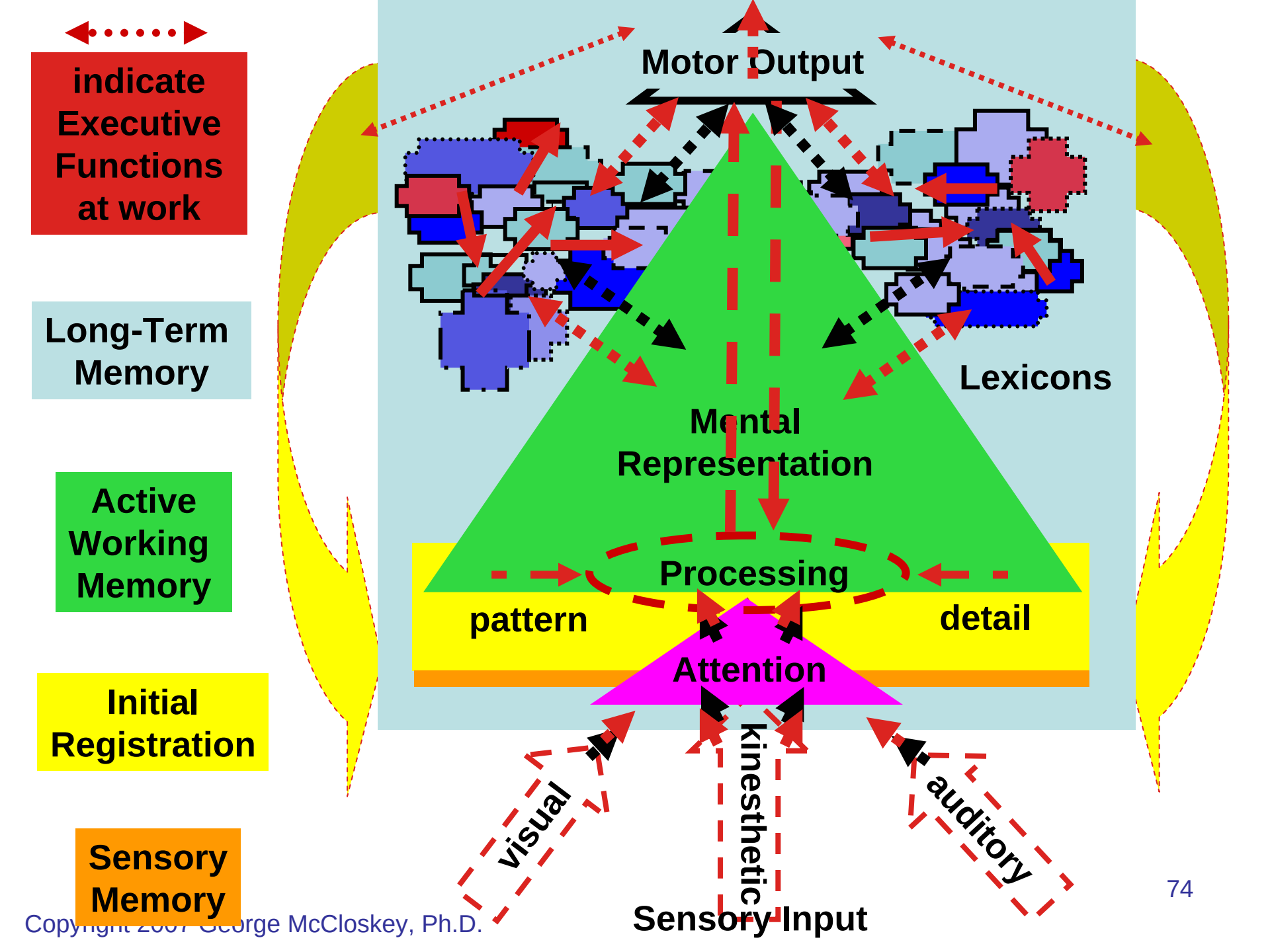
Executive Functions and Memory

- Executive Functions play a critical role in information processing within the various time signatures.
- Executive Functions are especially critical in cueing and directing retrieval of information from Lexicons.

A dark color

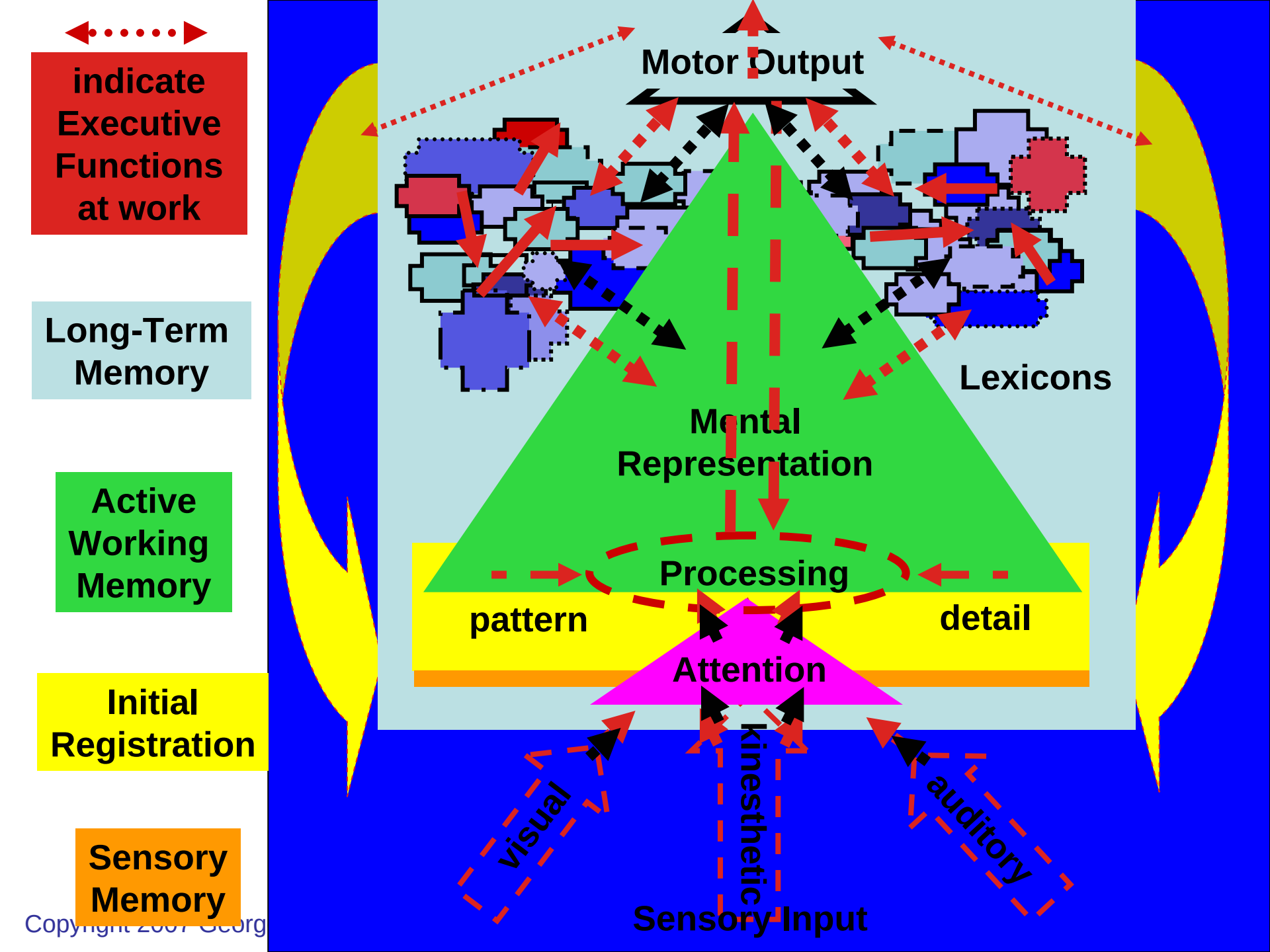
B R _ W _

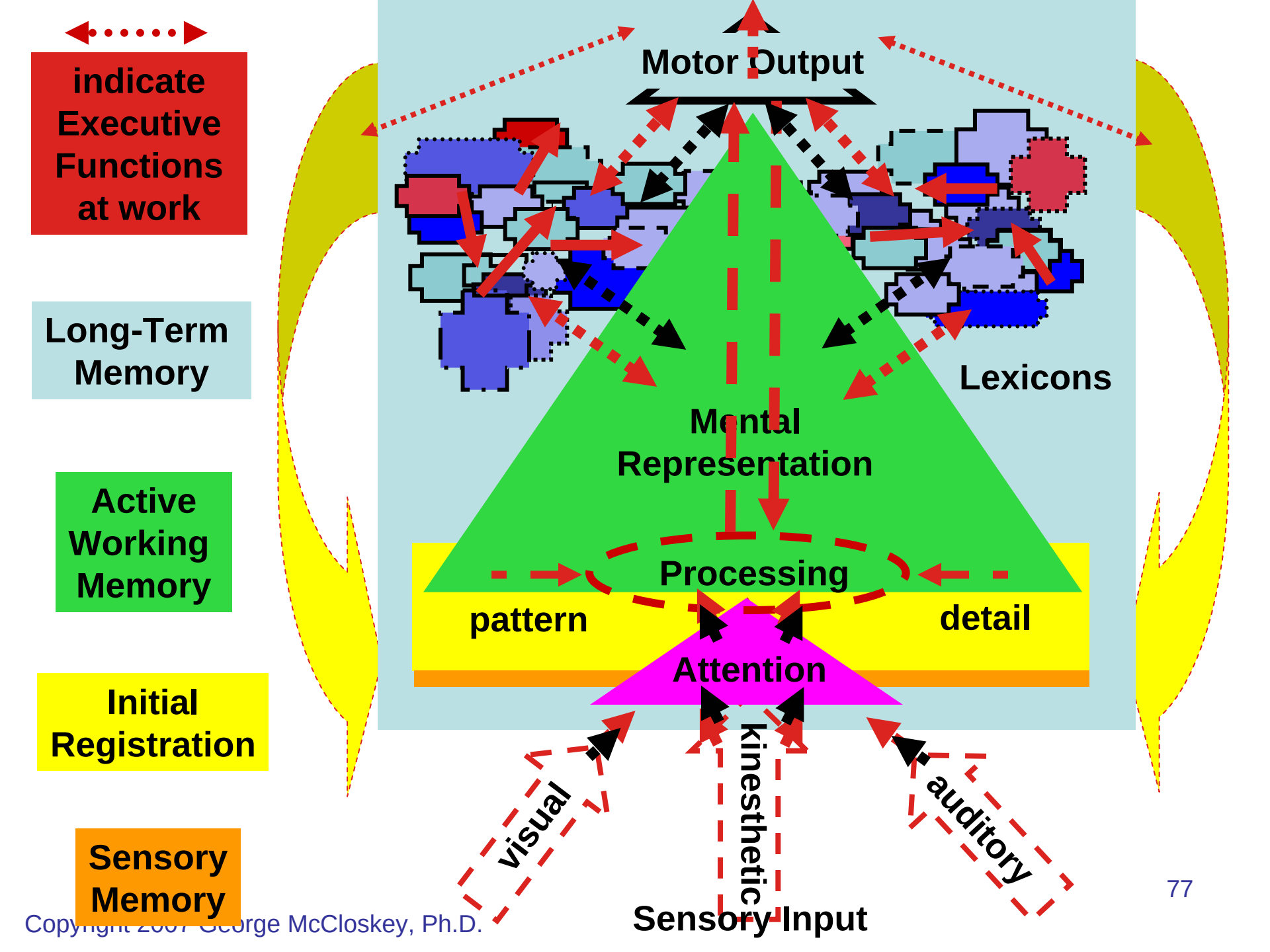
B R O W N

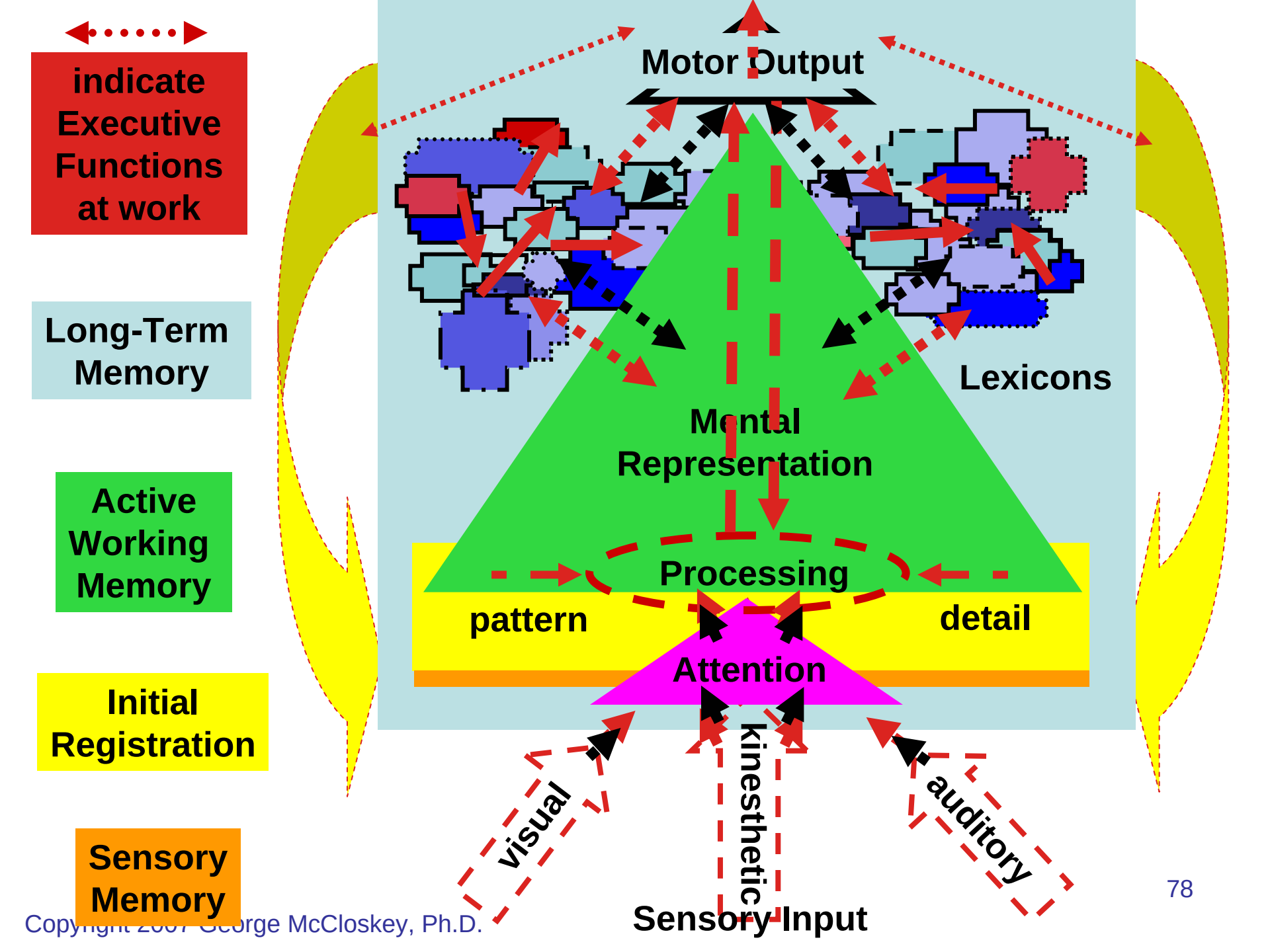


Emotions and Memory

- While individual Lexicons can carry an emotional tone, general mood states affect all aspects of memory and information processing.

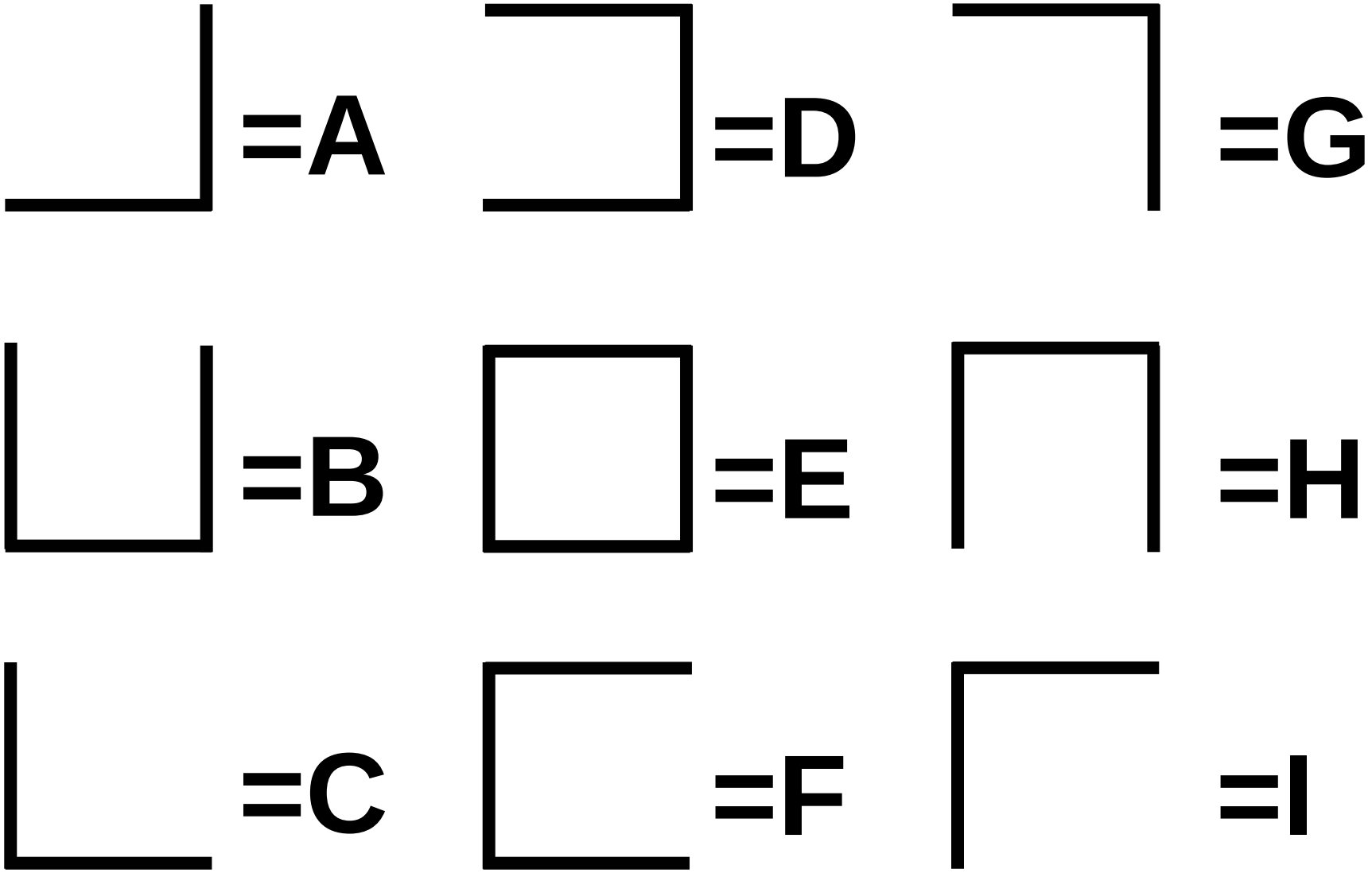


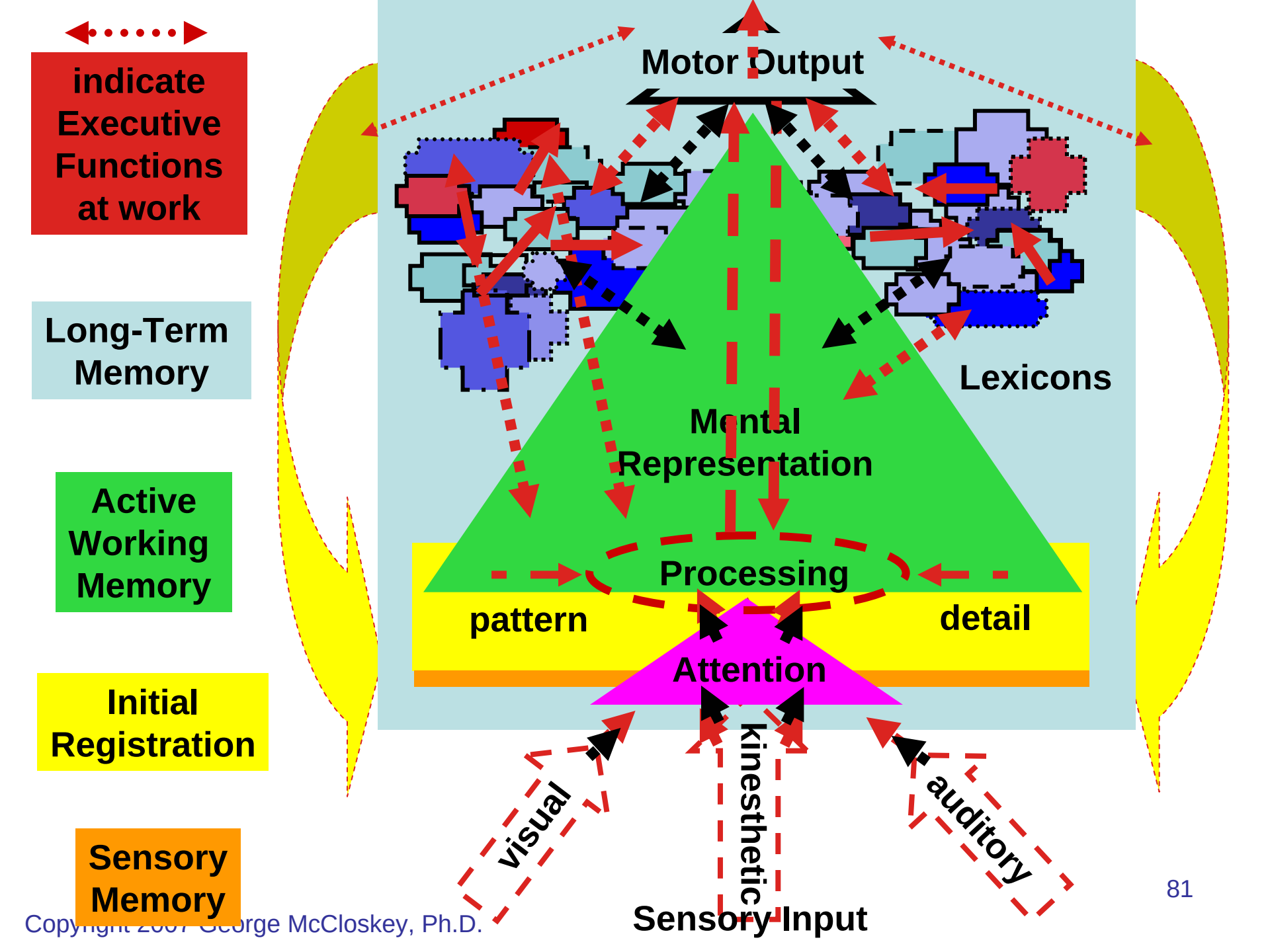




Initial Registration and Lexicon Building

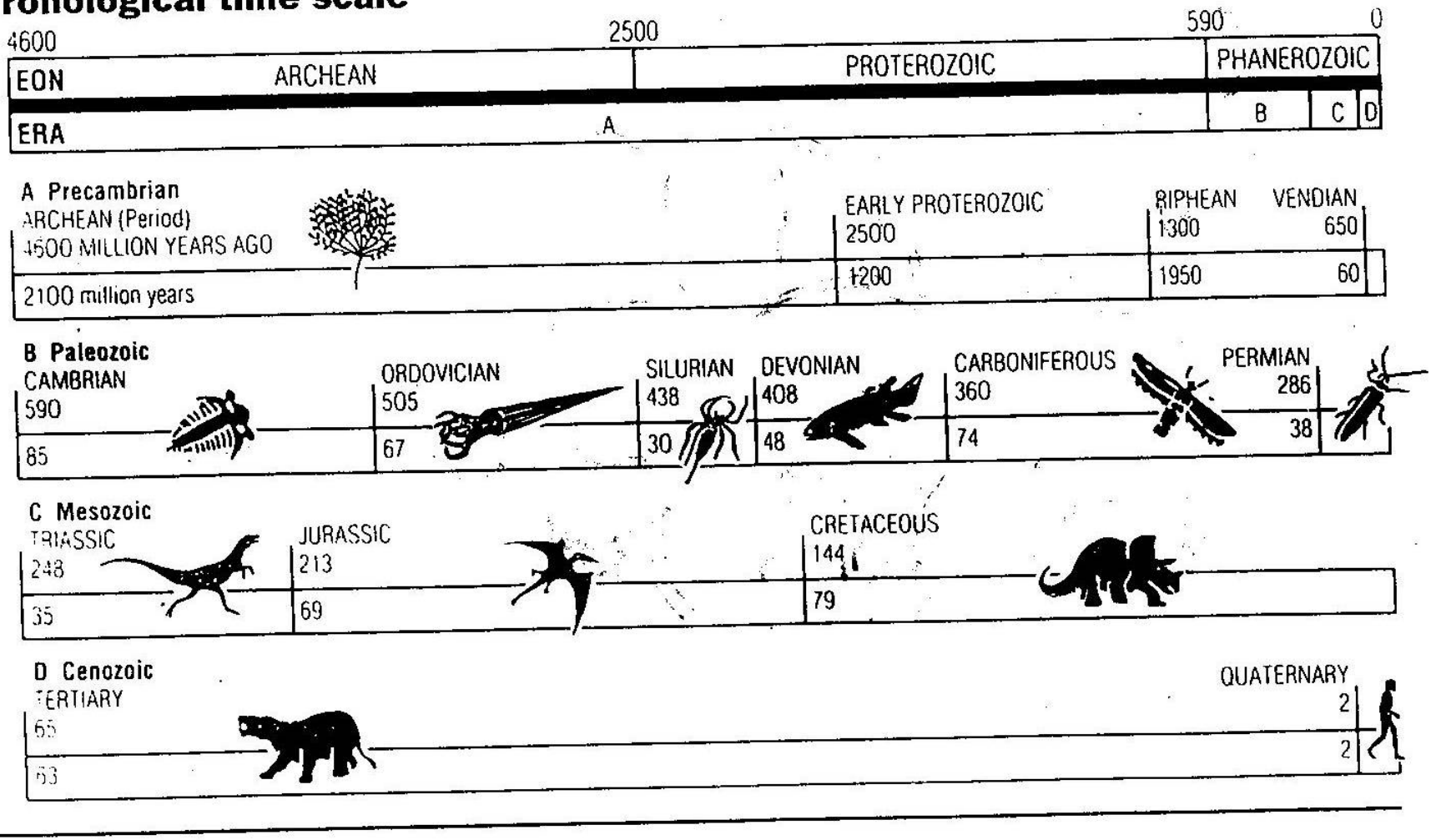
- Initial registration and transfer of information to lexicons can be aided through the use of strategies.
- These strategies can be built into the instructional process to optimize learning.





Geochronological time scale

241



1 Day =
12 Million Years

Bacterium?

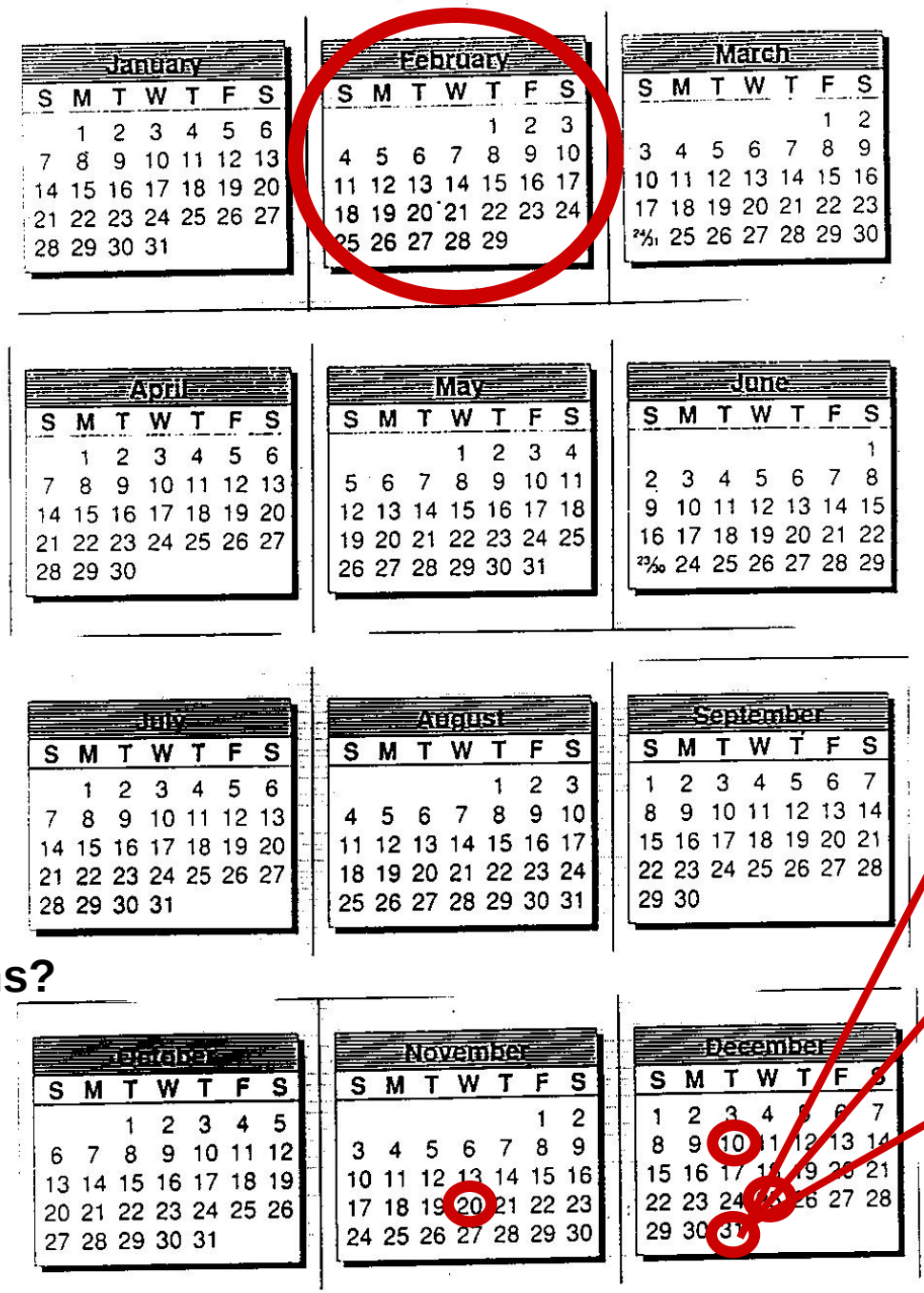
Fishes?

Dinosaurs?

Humans?

Homo Sapiens
Species of Humans?

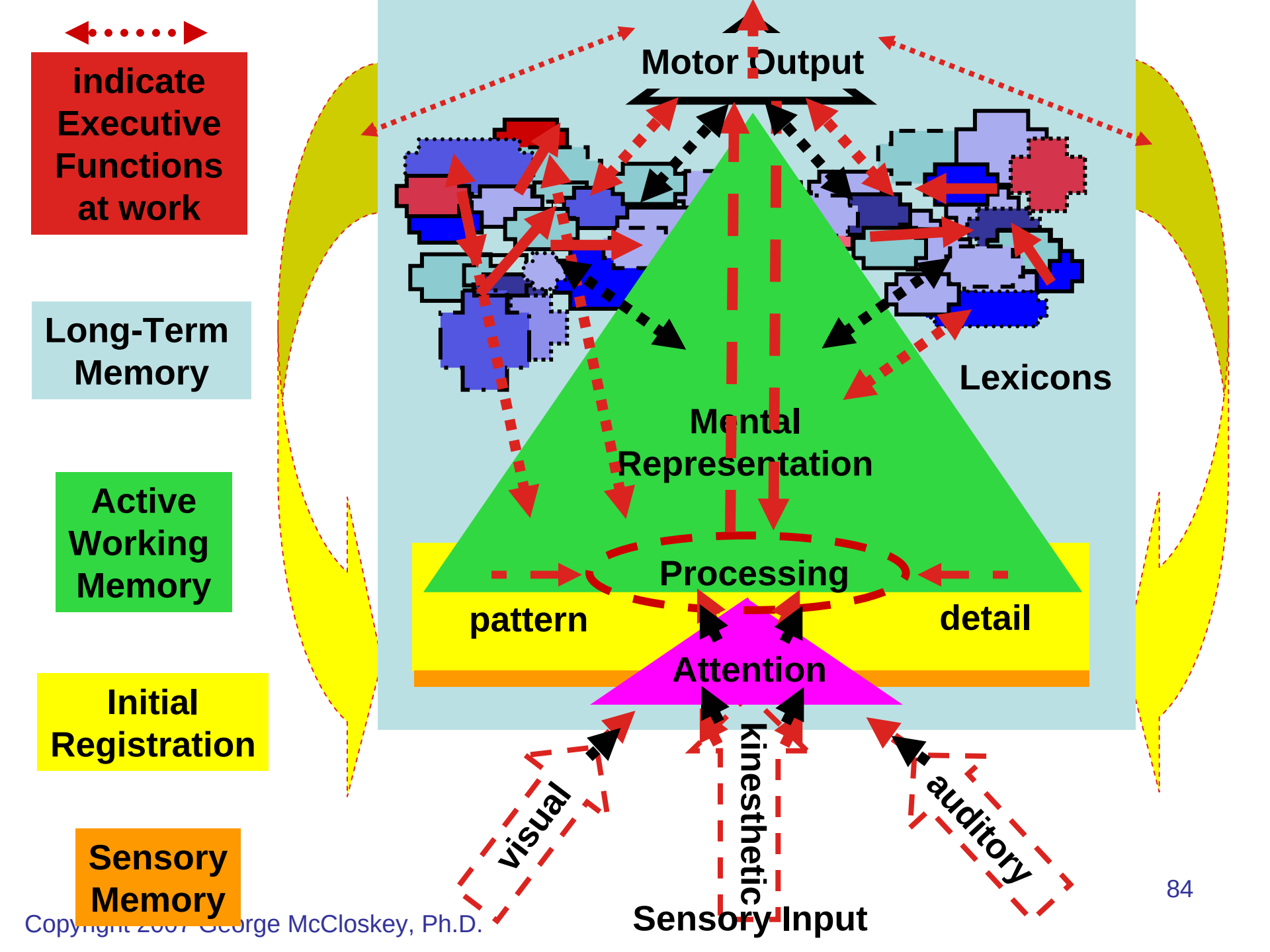
Recorded
History?

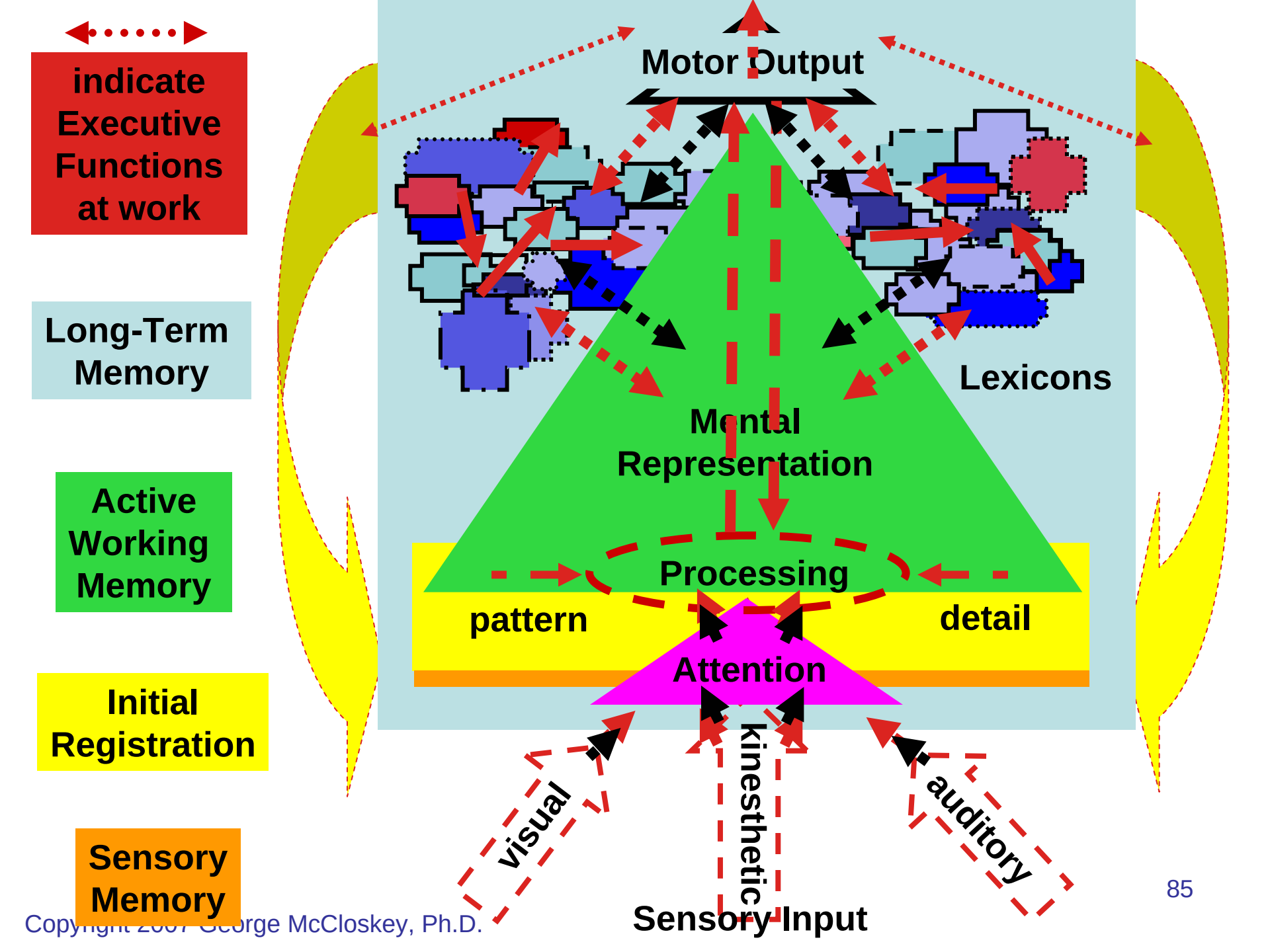


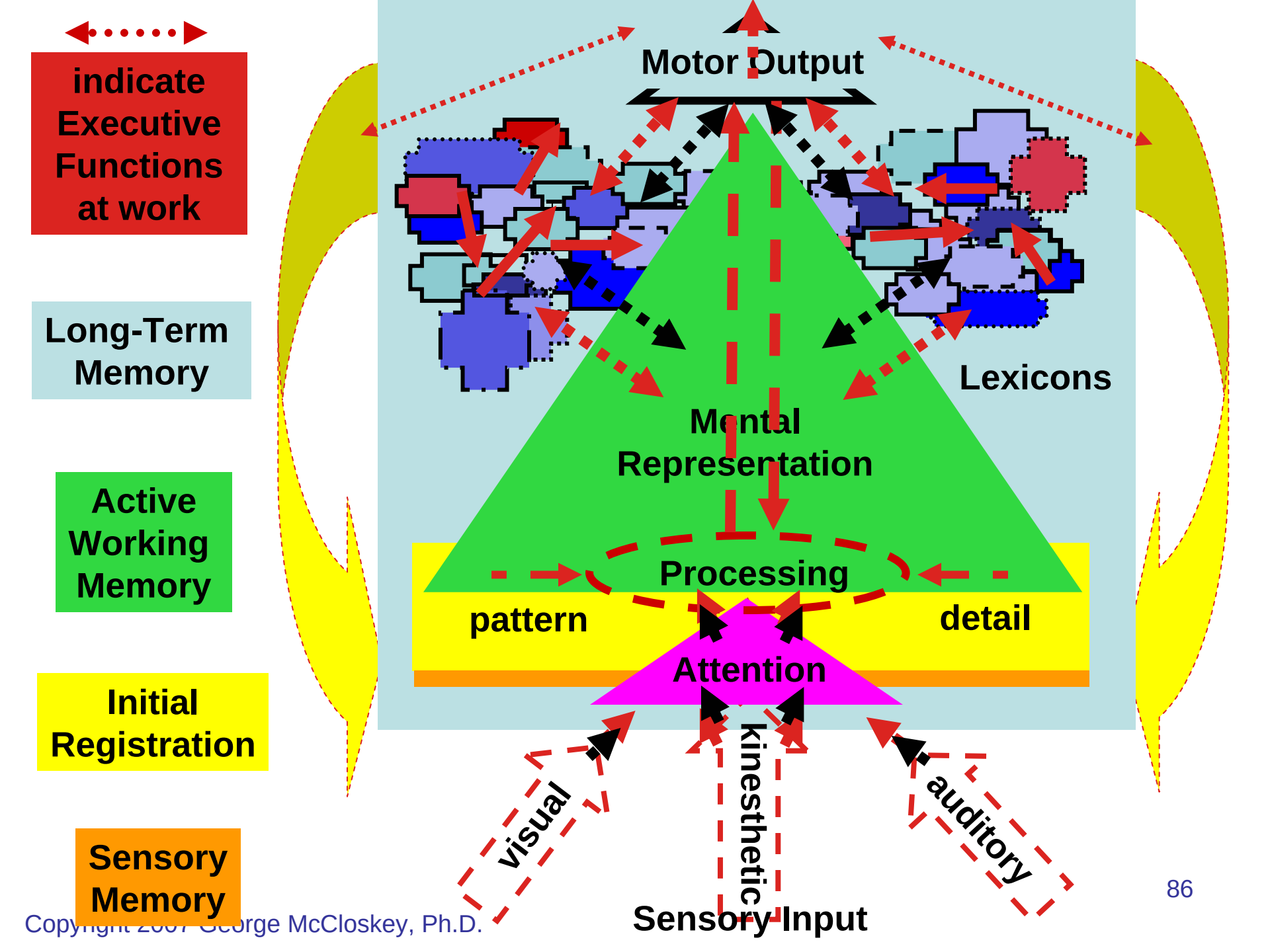
Afternoon of 12/31

11:45 pm 12/31

11:59 pm 12/31







Assessing Initial Registration and Active Working Memory

Digit Span Forward	16%ile	84%ile
Digit Span Backward	16%ile	50%ile
Letter-Number Sequencing	50%ile	50%ile
Arithmetic	84%ile	16%ile
WISC-IV WMI	**89**	**109**

Assessment Implications for Classroom Instruction

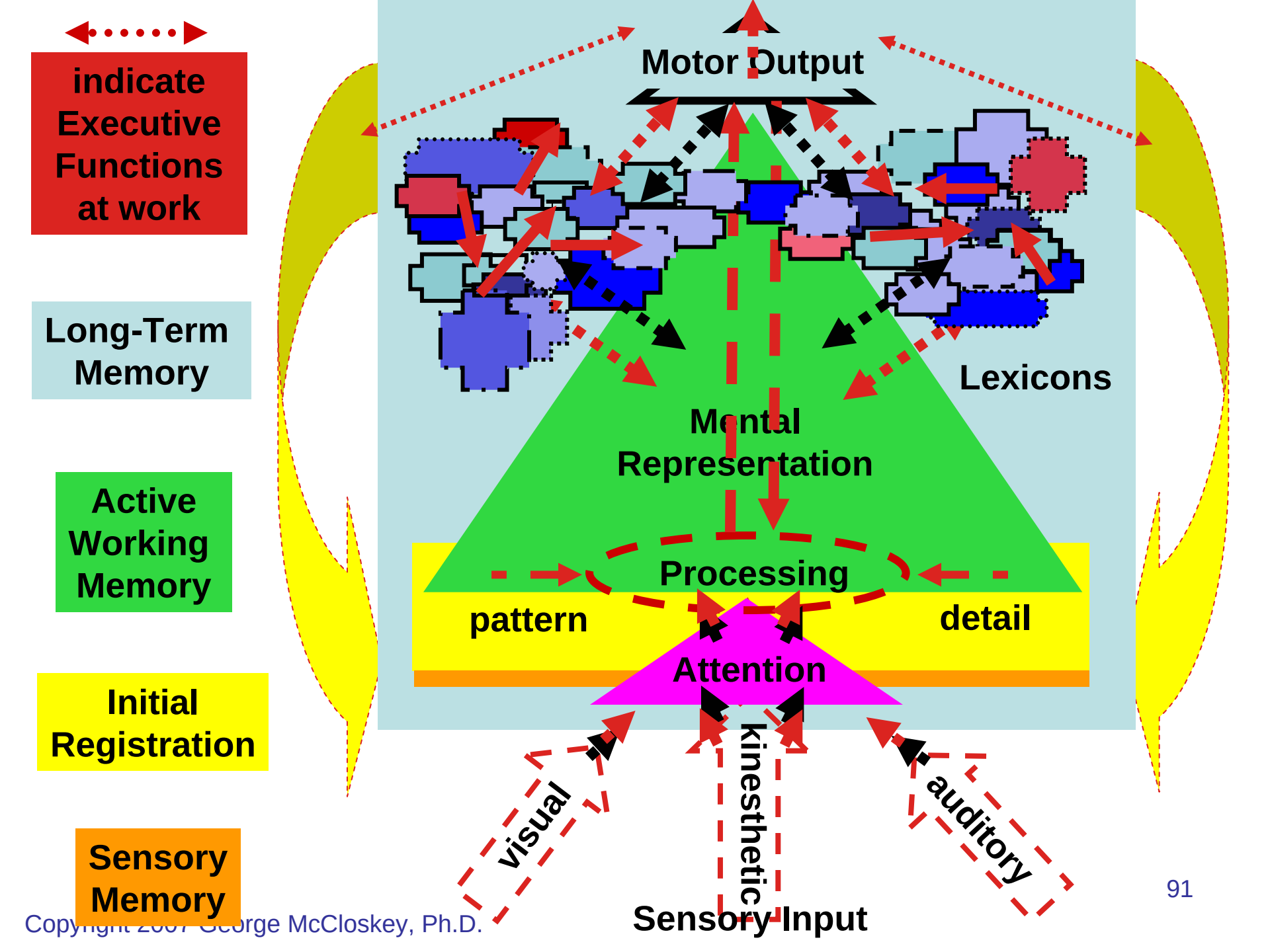
- The more instruction resembles “an unrelated load of crap” – like digit span – the more the first student will struggle.
- The more instruction incorporates meaningful context for cueing and guiding manipulation of information within the active working memory time frame, the better the first student will perform.

Assessment Implications for Classroom Instruction

- The more instruction requires literal, rote skill for registering information exactly as presented – like digit span – the better the second student will perform.
- The more instruction incorporates meaningful context but requires more elaborate manipulation of information within the active working memory time frame, the more the second student will struggle.

Improving Classroom Learning Across All Temporal Contexts

- Because memory is a time signature and not a skill, strategy, or lexicon, we cannot really increase or improve it.
- What appear to be memory problems are really difficulties with the processing of information in one of more temporal contexts.
- Interventions for “memory problems” focus on helping students improve information processing in the various temporal contexts.



Improving Classroom Learning Across All Temporal Contexts

- Teachers can help to improve information processing across all temporal contexts by:
  - Helping students to emotionally prepare their brains for learning by engendering relaxed, positive emotional states.
  - Teaching students about information processing and temporal contexts. Building a common lexicon that can be used to cue students about what capacities are needed for learning and production and when they are needed.

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help to improve information processing across all temporal contexts by:
  - Helping students use the information processing capacities (abilities, processes, skills, strategies, lexicons) they do possess as effectively as possible.
  - Teaching and modeling new strategies for improving information processing efficiency.

Improving Classroom Learning Across Temporal Contexts

- Teachers can help to improve information processing across all temporal contexts by:
  - Helping students learn how to effectively compensate for information processing weaknesses
- Teachers can help to improve information processing during the Initial Registration time signature by:
  - Helping students to “be in the now.”

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “be in the now” by:
  - Helping students to anticipate the “now” moment
    - Cue students about the Lexicons that are likely to be needed for processing information in the “now” moment (Initial Registration)
  - Announcing the arrival of the “now” moment
    - Cue perception of, and attention to, the “now” moment

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “be in the now” by:
  - Expanding the “now” moment
    - Present important information at a slower pace
  - Embellishing the “now” moment
    - Provide patterns through which details can be registered and organized more easily (e.g., changes in intonation and emphasis; visual aids, mnemonics, frameworks)
    - Use examples that create a larger context for the “now” moment

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “be in the now” by:
  - Revisiting the “now” moment
    - Repeat information (immediately or at a later time) as many times as needed
- Teachers can help to improve information processing during the Active Working Memory time signature by:
  - Helping students to “be in the future.”

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “be in the future” by:
  - Helping students to anticipate the “future”
    - Cue students about the upcoming need to extend information processing beyond the “now” moment
    - Cue students about the kinds of information processing resources likely to be needed during extended processing

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “be in the future” by:
  - Announcing the arrival of the “future”
    - Cue students when it is time to make the shift to extending information processing beyond the “now” moment
    - Encourage students to make extending information processing into the future a frequent habit

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “be in the future” by:
  - Embellishing the “future”
    - Refresh the active workspace by
      - Repeating information
      - Providing visual aids, especially ones that help to organize information
      - Provide examples or elaboration that offers a larger or stronger context for processing into the “future”
    - For students who are extremely poor at “being in the future,” provide a “take home travelogue.”

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help to improve information processing during the Long Term time signature by:
  - Helping students to “preserve the past.”
- Teachers can help students to “preserve the past” by:
  - Helping students collect information with which they can remember the past; make Lexicon building a conscious experience

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to "preserve the past" by:
  - Helping students to anticipate the need to "visit the past"
    - Cue students about the Lexicons that are likely to be needed for processing information in the "now" moment (Initial Registration) or needed to extend processing into the "future"
  - Announcing the need to "visit the past"
    - Cue the use of retrieval processes for accessing Lexicons

Improving Classroom Learning Across All Temporal Contexts

- Teachers can help students to “preserve the past” by:
  - Guiding students on their “visit to the past”
    - Cue students about which Lexicons need to be accessed and what specific information needs to be retrieved from the Lexicons
  - Encourage preservation of, and frequent visits to, “the past”
    - Help students to see the benefits of building and accessing Lexicons to find solutions for the “now” and the “future”