

What Are Executive Functions?

- Directive capacities of the mind
- Multiple in nature, not a single capacity
- Cue the use of other mental abilities
- Direct and control perceptions, thoughts, actions, and to some degree emotions
- Part of neural circuits that are routed through the frontal lobes

Homunculus - Literally, a tiny person. In psychology, the unproductive and paradoxical idea that a person's behavior depends upon the behavior of another person-like entity located deeper inside that person.

-from *The Society of Mind*, Marvin Minsky 1985



A TABLE OF NEURODEVELOPMENTAL CONSTRUCTS



all kinds of minds[®]

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Dedicated to the Education of All Children

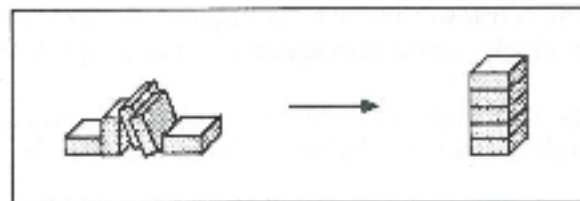
ATTENTION	TEMPORAL-SEQUENTIAL ORDERING	SPATIAL ORDERING	MEMORY	LANGUAGE	NEUROMOTOR FUNCTIONS	SOCIAL COGNITION	HIGHER ORDER COGNITION
MENTAL ENERGY CONTROLS <ul style="list-style-type: none"> > Alertness > Mental Effort > Sleep/Arousal Balance > Performance Consistency 	SEQUENTIAL AWARENESS SEQUENTIAL PERCEPTION SEQUENTIAL MEMORY SEQUENTIAL OUTPUT TIME MANAGEMENT HIGHER SEQUENTIAL THINKING	SPATIAL AWARENESS SPATIAL PERCEPTION SPATIAL MEMORY SPATIAL OUTPUT MATERIAL MANAGEMENT HIGHER SPATIAL THINKING	SHORT-TERM MEMORY <ul style="list-style-type: none"> > Salience Determination > Recoding > Depth/Detail of Processing ACTIVE WORKING MEMORY <ul style="list-style-type: none"> > Idea Maintenance > Task Component Maintenance > Proximal/Distal Planning > Short-Term to Long-Term Memory Linkage LONG-TERM MEMORY Consolidation <ul style="list-style-type: none"> > Paired Association Filing > Procedure Filing > Rule/Pattern/Schema Filing > Category Filing Access <ul style="list-style-type: none"> > Association > Pattern Recognition/Method Transfer > Recall 	RECEPTIVE LANGUAGE <ul style="list-style-type: none"> > Phonological Processing > Morphological Sense > Semantic Understanding > Sentence Comprehension > Discourse Processing EXPRESSIVE LANGUAGE <ul style="list-style-type: none"> > Articulation/Fluency > Semantic Use > Word Retrieval > Sentence Formulation > Discourse Production > Verbal Elaboration 	GROSS MOTOR FUNCTION <ul style="list-style-type: none"> > Outer Spatial Processing > Body Position Sense > Gross Motor Production > Gross Motor Memory > Gross Motor Problem Solving/Logic FINE MOTOR FUNCTION <ul style="list-style-type: none"> > Eye-Hand Coordination > Fine Motor Procedural Memory > Fine Motor Problem Solving/Logic GRAPHOMOTOR FUNCTION <ul style="list-style-type: none"> > Pre-Visualization > Graphomotor Memory > Graphomotor Production > Graphomotor Feedback 	VERBAL PRAGMATICS <ul style="list-style-type: none"> > Communicational/Interpretation of Feelings > Code Switching > Topic Selection/Maintenance > Humor Regulation > Conversational Technique SOCIAL BEHAVIORS <ul style="list-style-type: none"> > Self-Marketing > Social Information Processing > Collaboration > Initiation technique > Social Control Regulation > Timing/Staging Relationships > Social Conceptualization > Conflict Resolution POLITICAL ACUMEN	CONCEPT FORMATION <ul style="list-style-type: none"> > Verbal Conceptualization > Non-Verbal Conceptualization > Process Conceptualization CRITICAL THINKING CREATIVITY/ BRAINSTORMING PROBLEM SOLVING RULE USE REASONING/ LOGICAL THINKING MENTAL REPRESENTATION

CROSS-CONSTRUCT PHENOMENA

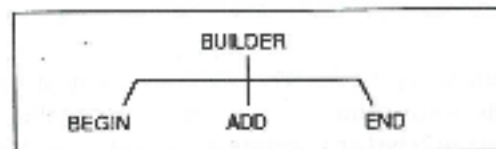
Junctions between Functions • Rate of Processing/Production • Volume/Chunk Size Accommodation • Strategy Use • Self-Monitoring/Regulation
 Domain-Specific Function • Meta-Awareness



Imagine a child playing with blocks, and imagine that this child's mind contains a host of smaller minds. Call them mental agents. Right now, an agent called *Builder* is in control. *Builder's* speciality is making towers from blocks.

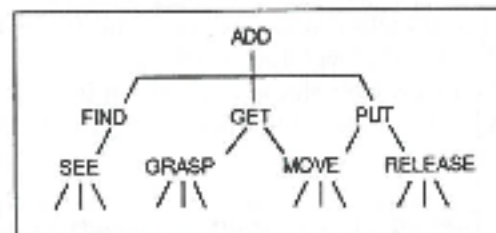


Our child likes to watch a tower grow as each new block is placed on top. But building a tower is too complicated a job for any single, simple agent, so *Builder* has to ask for help from several other agents:



Choose a place to start the tower.
Add a new block to the tower.
Decide whether it is high enough.

In fact, even to find another block and place it on the tower top is too big for a job for any single agent. So *Add*, in turn, must call for other agents' help. Before we're done, we'll need more agents than would fit in any diagram.

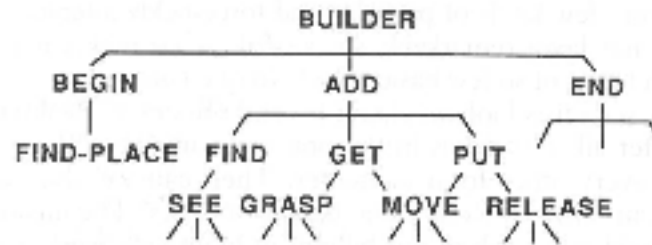


First ADD must FIND a new block.
Then the hand must GET that block and PUT it on the tower top.

AGENT BUILDER

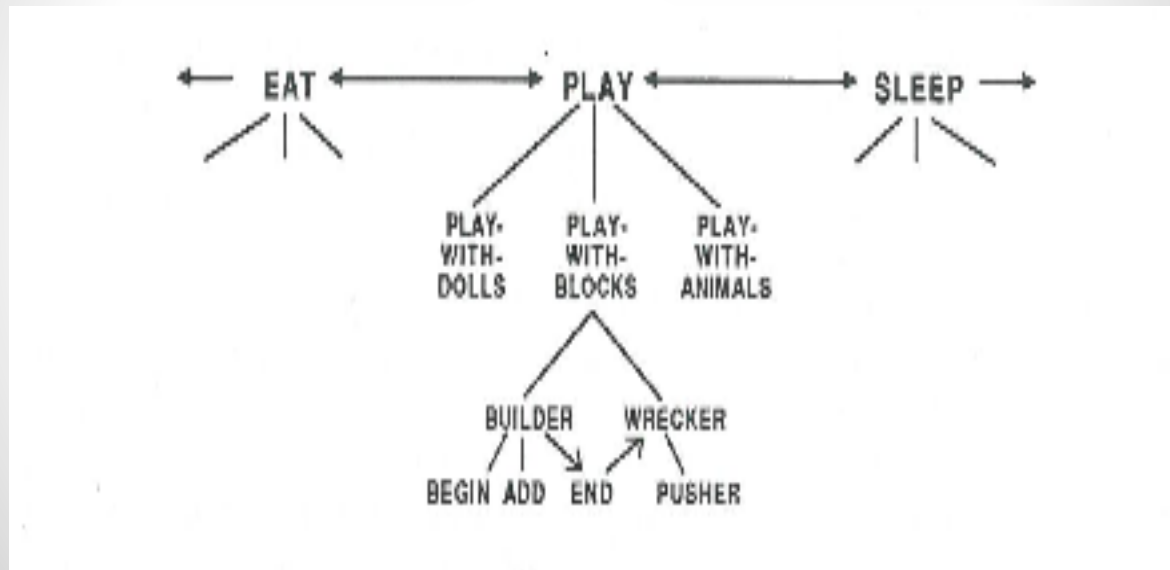
PUT BEGIN
ADD END
SEE FIND
GET MOVE
GRASP RELEASE
 FIND-PLACE

Agents by Themselves



Agents in a Bureaucracy

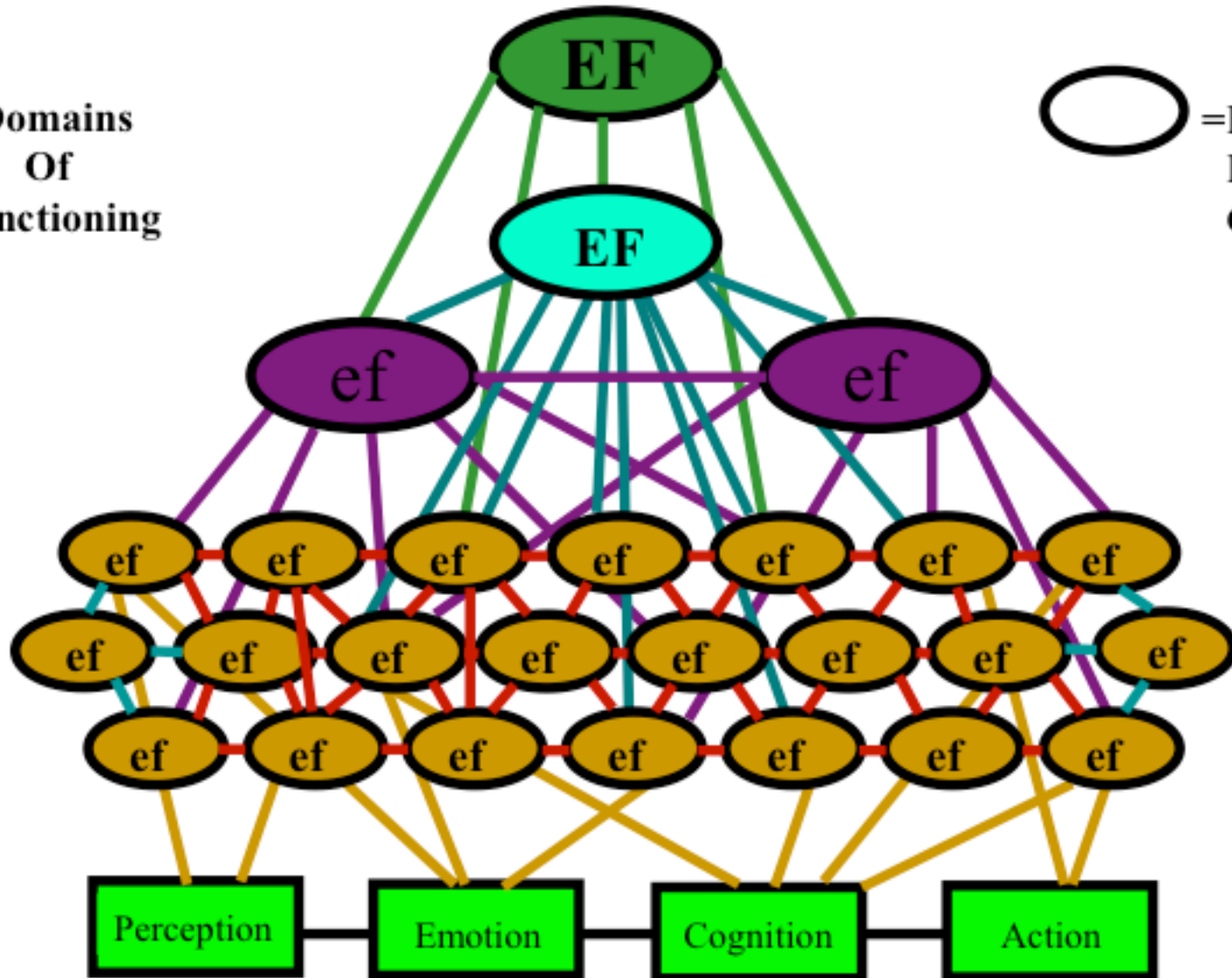
3 AGENTS

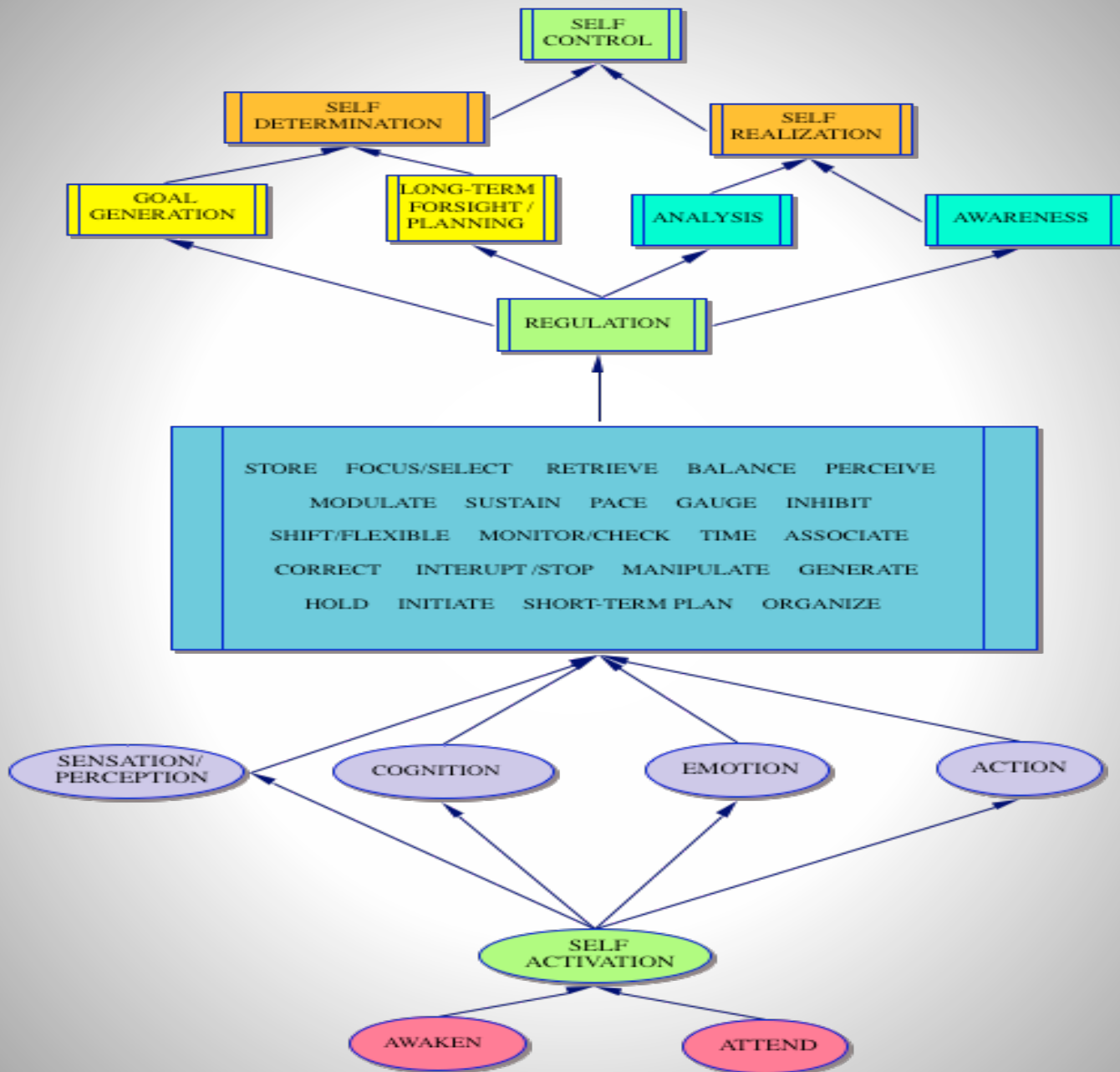


Co-Conductors in a Holarchical Model of EF

□ = Domains
Of
Functioning

○ = Executive
Function
Capacity

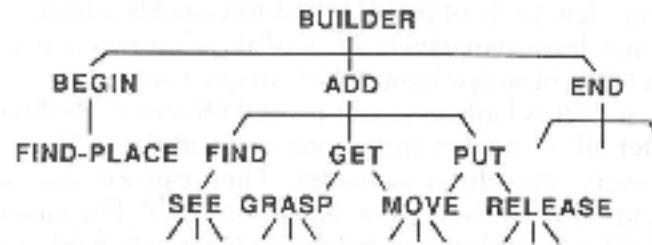




AGENT BUILDER

PUT BEGIN
ADD END
SEE FIND
GET MOVE
GRASP RELEASE
 FIND-PLACE

Agents by Themselves

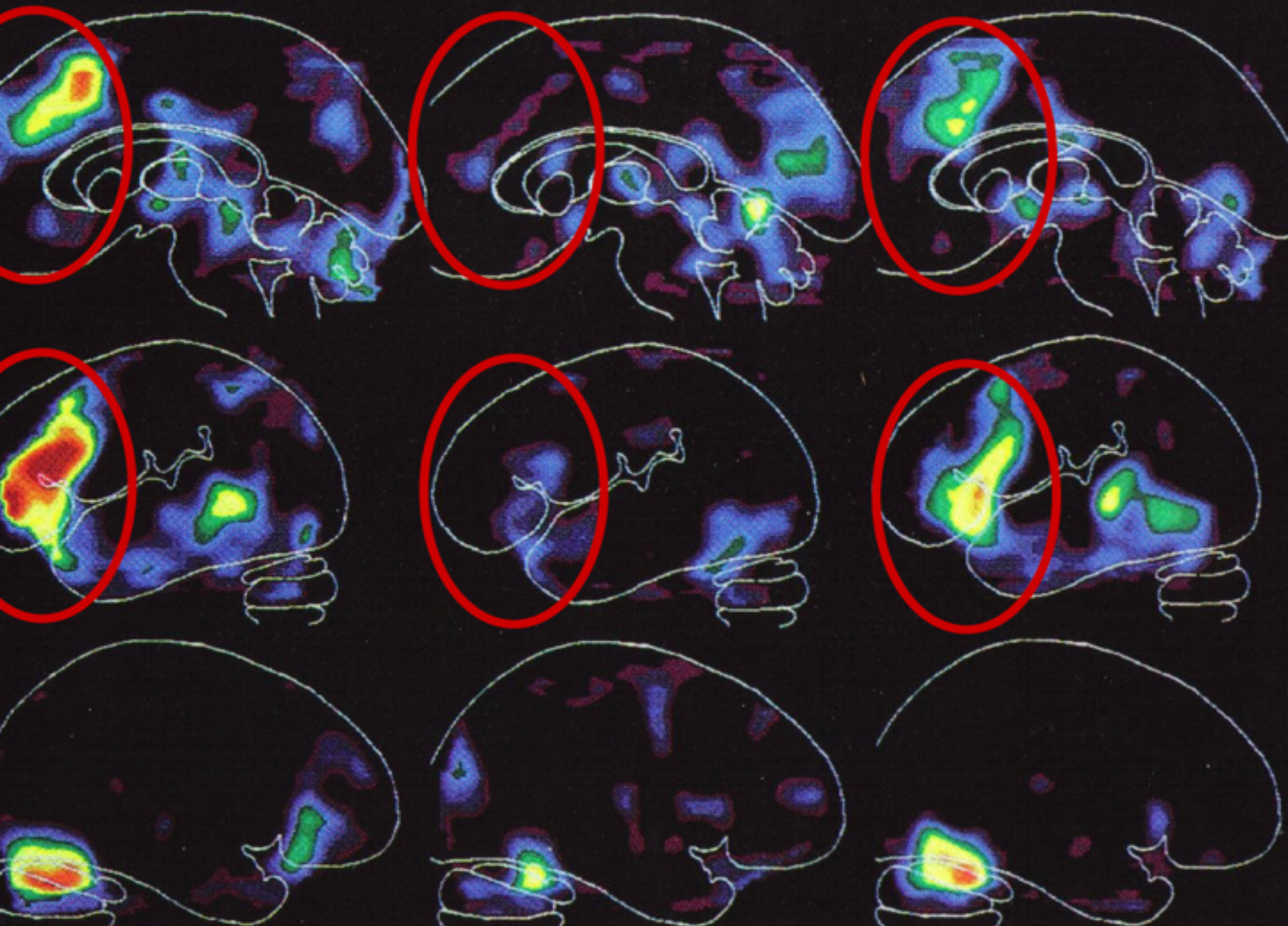


Agents in a Bureaucracy

NAIVE

PRACTICED

NOVEL



Rule:

Name the ink color.

red blue green blue green

red blue red green red

blue green blue red blue red blue red blue red

blue green blue green red green blue red blue green

red green red blue green red green red blue green

blue green blue red green blue red green red green

green blue red blue green red blue green red blue



Rules:

1. **blue** - Name the ink color.

2. **red** - Read the word.

blue red **green** red **blue**

green **red** **green** red **blue**

green **blue** **green** **blue** **red** **green** red **green** red **blue**

red **blue** red **green** **blue** **green** **blue** **red** red **blue**

blue red **green** **red** red **green** **blue** **red** **blue** **red**

blue **green** **blue** **green** **red** red **green** red **blue** **green**

green **red** red **blue** **green** **blue** red **green** **green** **red**



Stroop Test

Rule:

Name the ink color.

red blue green blue green

red blue red green red

blue green blue red blue red blue red blue red

blue green blue green red green blue red blue green

red green red blue green red green red blue green

blue green blue red green blue red green red green

green blue red blue green red blue green red blue



Memory and Retrieval

8.1 K- LINES: A THEORY OF MEMORY

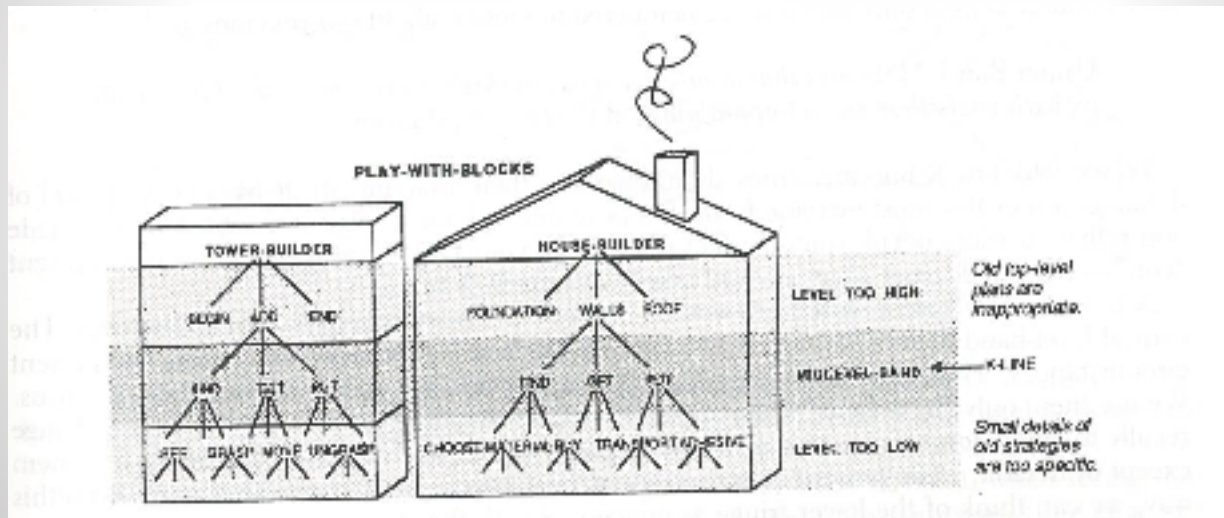
“You want to repair a bicycle. Before you start, smear your hands with red paint. Then every tool you need to use will end up with red marks on it. When you’re done, just remember that red means ‘good for fixing bicycles.’ Next time you fix a bicycle, you can save time by taking out all the red-marked tools in advance.

“If you use different colors for different jobs, some tools will end up marked with several colors. That is, each agent can become attached to many different K-lines. Later, when there’s a job to do, just activate the proper K-line for that kind of job, and all the tools used in the past for similar jobs will automatically become available.”

This is the basic idea of the K-line theory. But suppose you had tried to use a certain wrench, and it didn’t fit. It wouldn’t be so good to paint *that* tool red. To make our K-lines work efficiently, we’d need more clever policies. Still, the basic idea is simple: for each familiar kind of mental job, your K-lines can refill your mind with fragments of ideas you’ve used before on similar jobs. In such a moment, you become in those respects more like an earlier version of yourself.

Smear Your Hands With Paint

The Builder



12.9 THE EXCEPTION PRINCIPLE

What should one do with a law or rule that doesn't always work? We saw one way when we developed our uniframe for the *Block-Arch*. We simply kept changing it to fit each new example. But what if, after all that work, there still remain exceptions that don't fit?

The Exception Principle: It rarely pays to tamper with a rule that nearly always works. It's better just to complement it with an accumulation of specific exceptions.

All children learn that birds can fly and that animals that swim are fish. So what should they do when told that penguins and ostriches are birds that cannot fly, or that whales and porpoises are animals that swim but aren't fish? What should the children do with uniframe that no longer work so well? The exception principle says: Do not change them too hastily. We should never expect rules to be perfect but only to say what is typical. And if we try to modify each rule, to take each exception into account, our descriptions will become too cumbersome to use. It's not so bad to start with "Birds can fly" and later change it into "*Birds can fly, unless they are penguins or ostriches.*" But if you continue to seek perfection, your rules will turn into monstrosities:

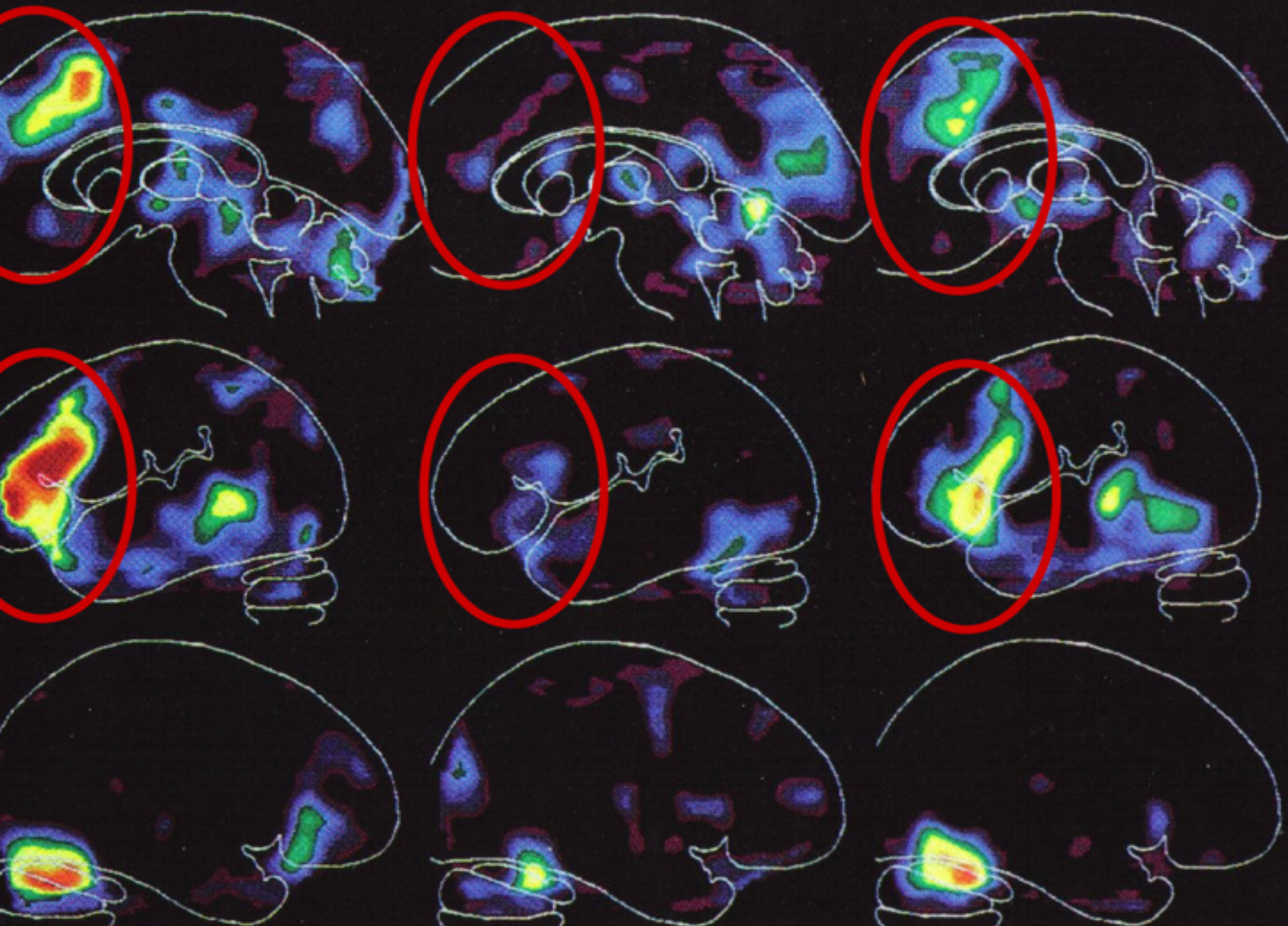
Birds can fly, unless they are penguins and ostriches, or if they happen to be dead, or have broken wings, or are confined to cages, or have their feet stuck in cement, or have undergone experiences so dreadful as to render them psychologically incapable of flight.

Unless we treat exceptions separately, they'll wreck all the generalizations we may try to make. Consider why the commonsense idea of *fish* is so useful. It is an accumulation of general information about a class of things that have much in common: animals that live in the water, have a certain sort of streamlined shape, and move by wriggling their bodies and fanning the water with various finlike appendages.

NAIVE

PRACTICED

NOVEL



Cognitive Overload

Establishing Learning Goals

- Deep organization based on meaning makes possible lasting learning.
- A learning goal has to be selective.
- A learning goal has to be specific.

Not such a great learning goal:

Today we are going to read chapter 4 about the Egyptians and answer the questions at the end of the chapter.

Or . . .

Today we are going to watch a video about the Egyptians.

A better learning goal:

Today I want us to be able to know 2 ways the Nile River shaped Egyptian Life.

Or even better . . .

Today we are all going to answer these questions about the Nile River:

1. How did the Nile impact agriculture?
2. Besides growing food, how else did the Nile help feed Egypt?

Episodic Demarcation

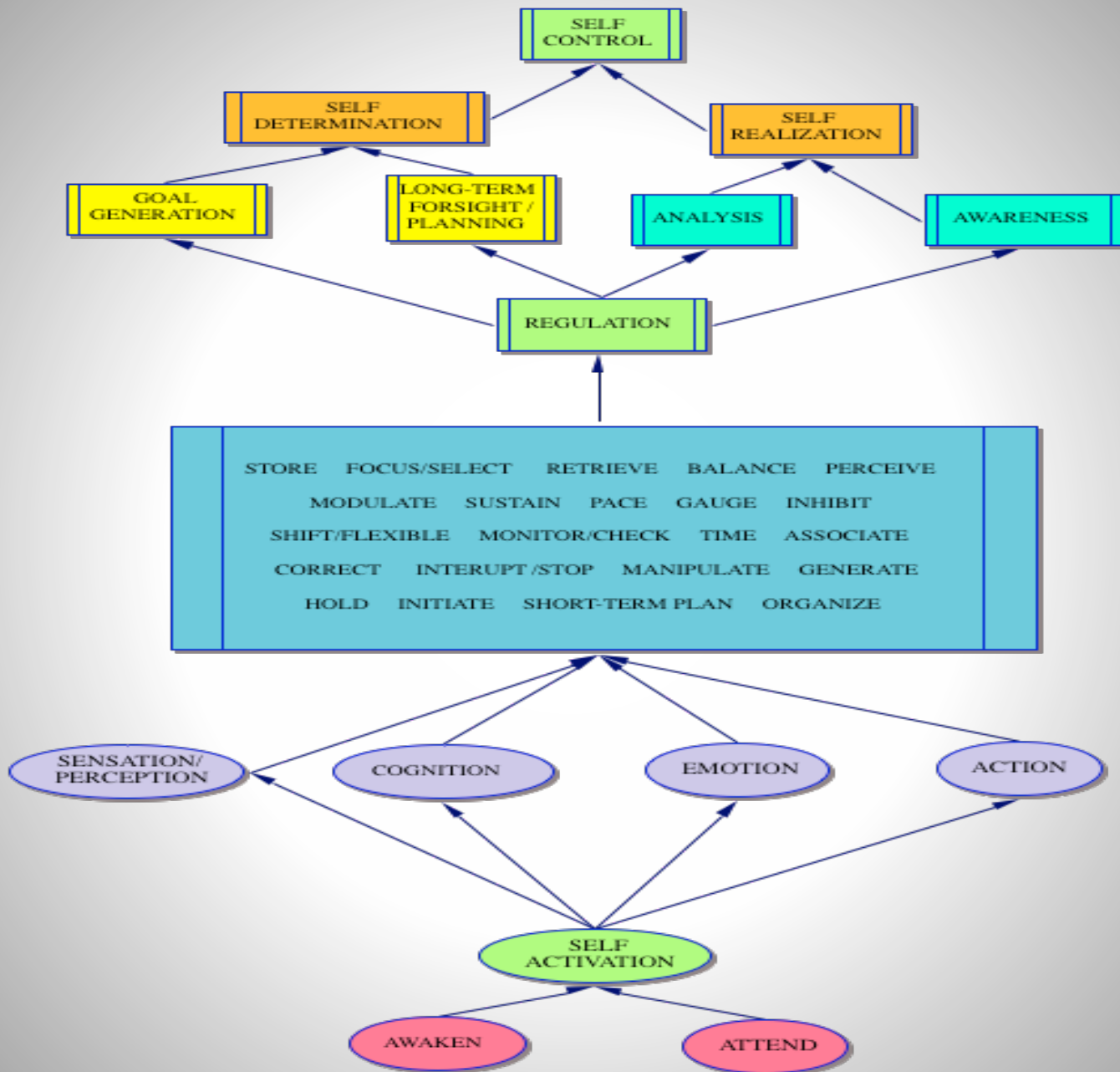
- Marks the beginning and ending of a learning session.
- Helps a student label a learning session.

Set Construction

- How much prior knowledge needs to be drawn forward for a task?
- Which “agencies” are marshaled?
- How complete or well-functioning are those agencies?
- What are the limits of the speed, amount, and accuracy of retrieval?

Overload

- When one or more of the higher “agencies” of Executive Function” has been overloaded
- Attention
- Working Memory
- Processing Speed



Interventions and Support

- Initially, provide intense intervention and support.
- Change intervention and support into prompted strategies.
- Work toward self-advocacy and social fluidity.