How Minds Work

The IDA Cognitive Cycle

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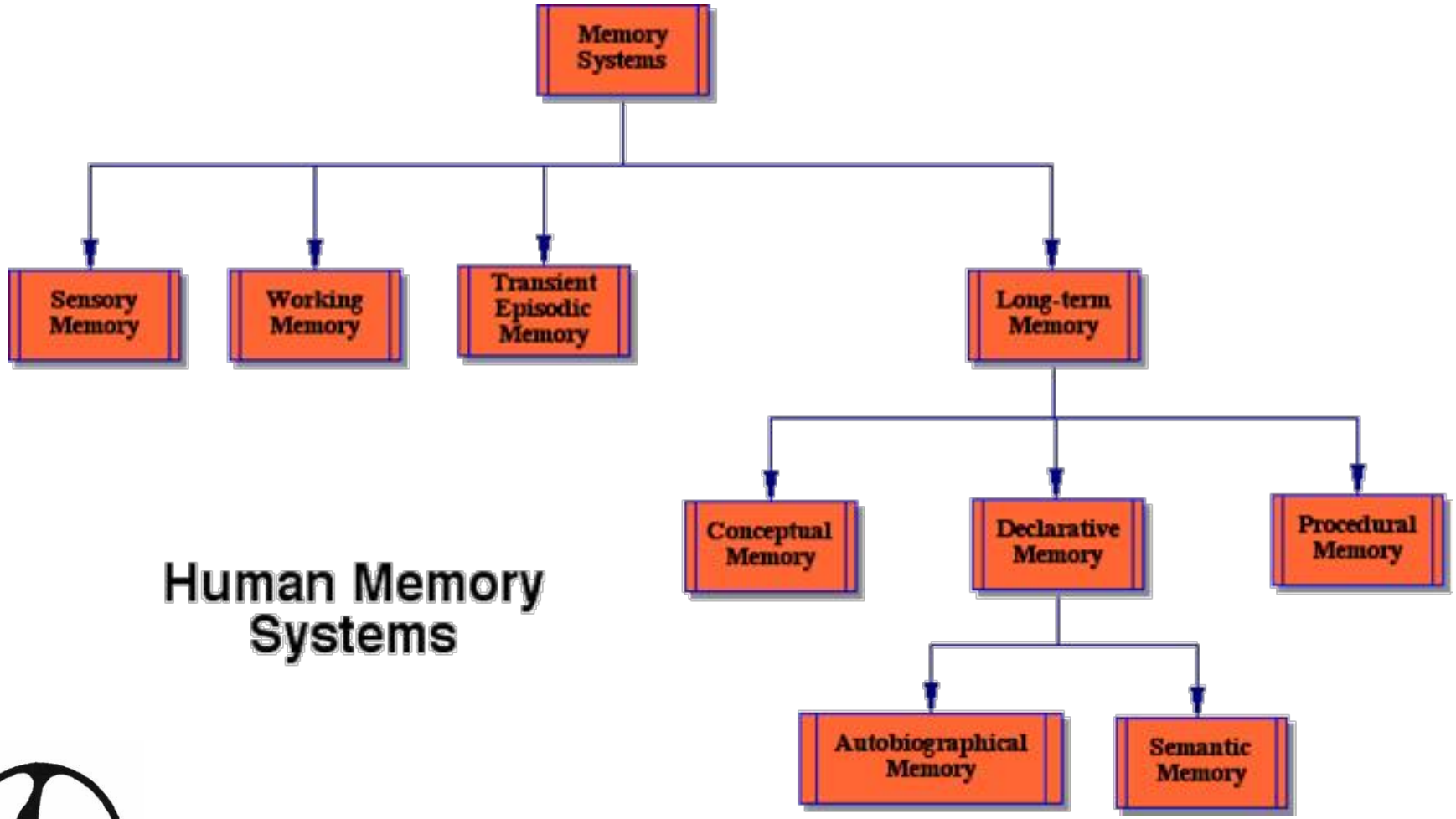
Memory Systems



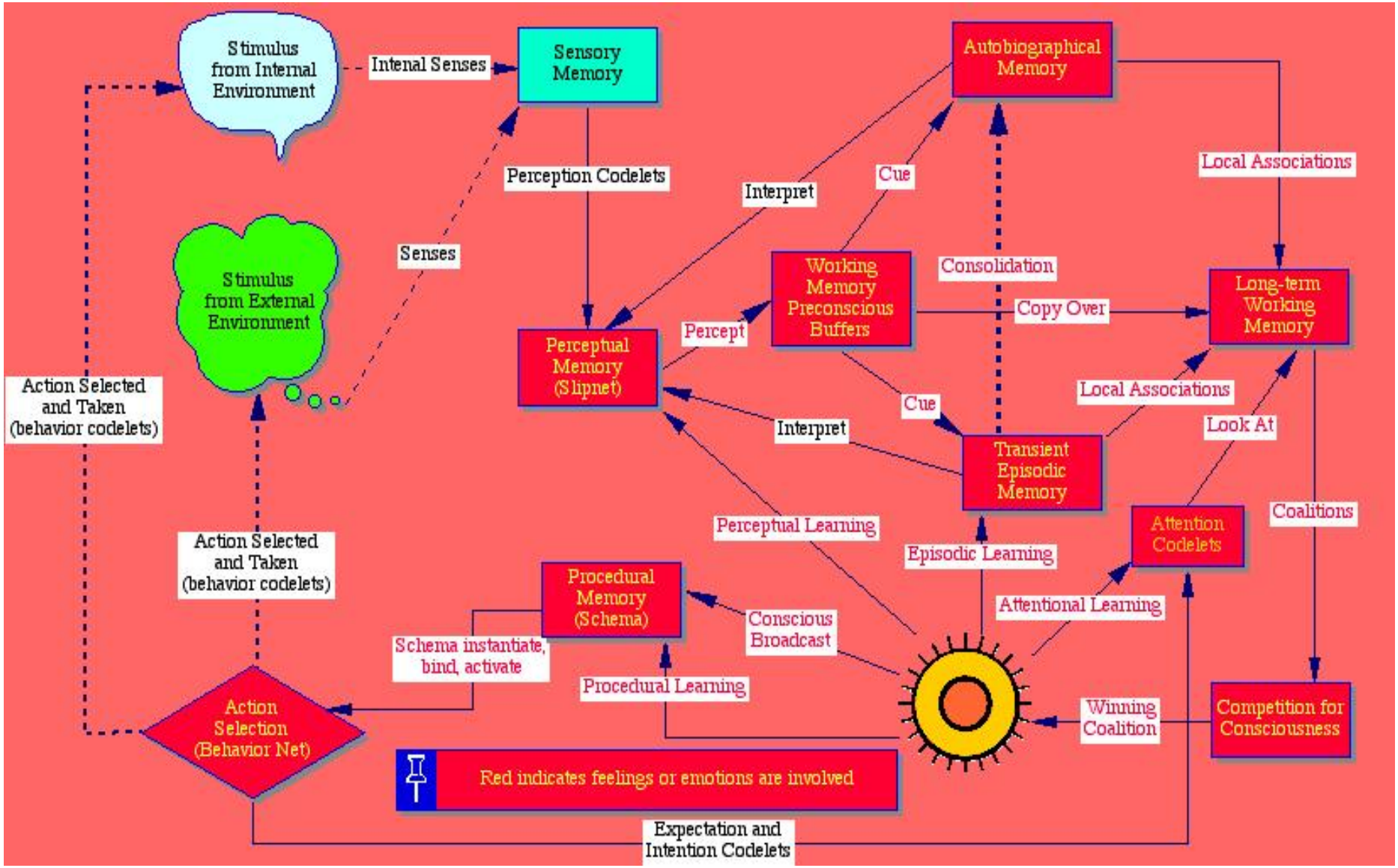
Human Memory Systems

Global Workspace Theory I

- The nervous system is a distributed parallel system with many different specialized processors
- Coalitions of processors compete for access to a Global workspace
- Contents are broadcast globally to all other processors

Global Workspace Theory II

- Recruit other processors needed for any degree of novel or problematic situation
- Unconscious contexts and context hierarchies influence consciousness
- Learning requires only consciousness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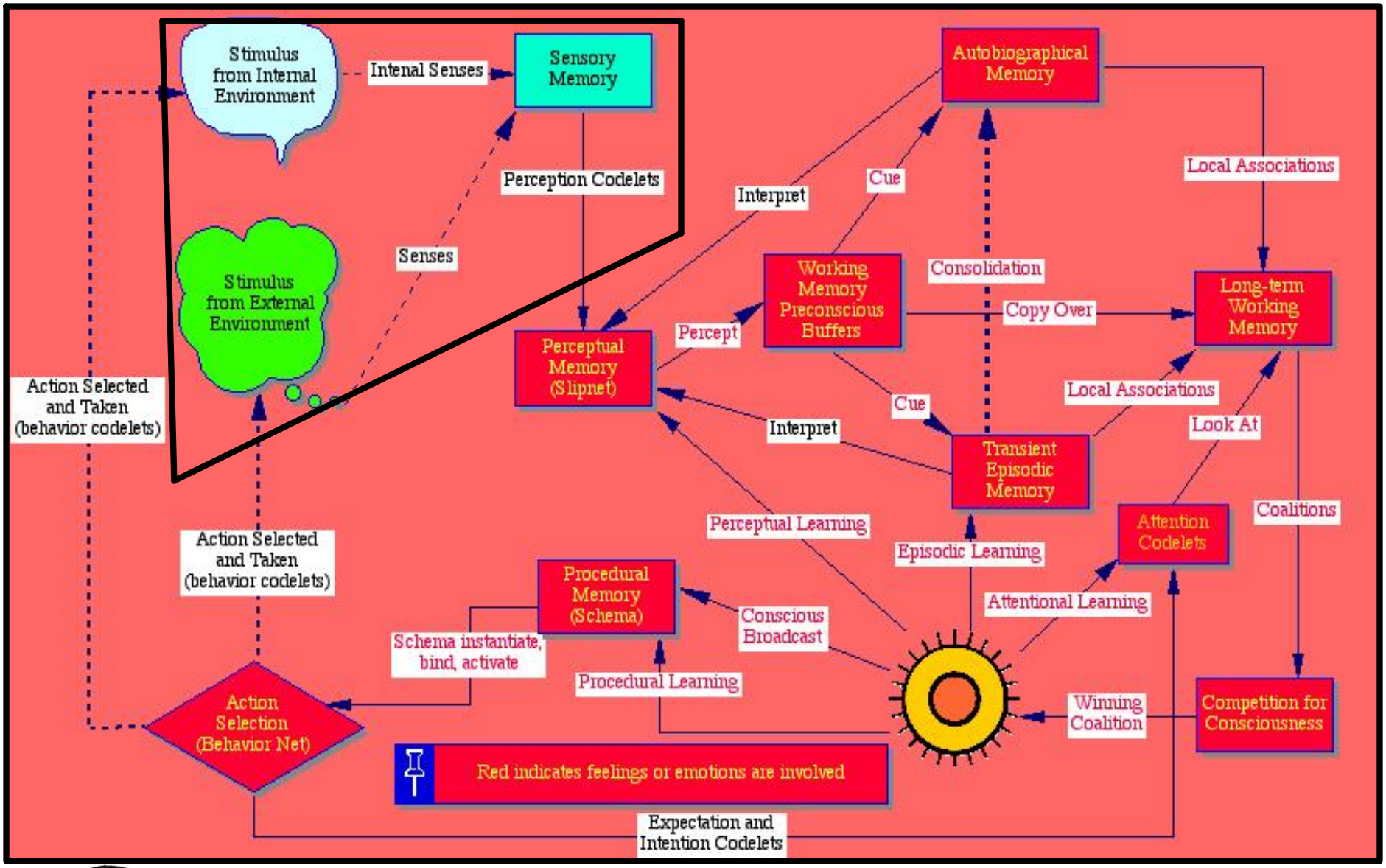
Expectation and Intention Codelets

Cognitive Cycle Processing

- Hypothesis— Like IDA's, human cognitive processing is via a continuing sequence of Cognitive Cycles
- Duration— Each cognitive cycle takes roughly 200 ms with steps 1 through 5 occupying about 80 ms
- Overlapping— Several cycles may have parts running simultaneously in parallel
- Seriality— Consciousness maintains serial order and the illusion of continuity
- Start— Cycle may start with action selection instead of perception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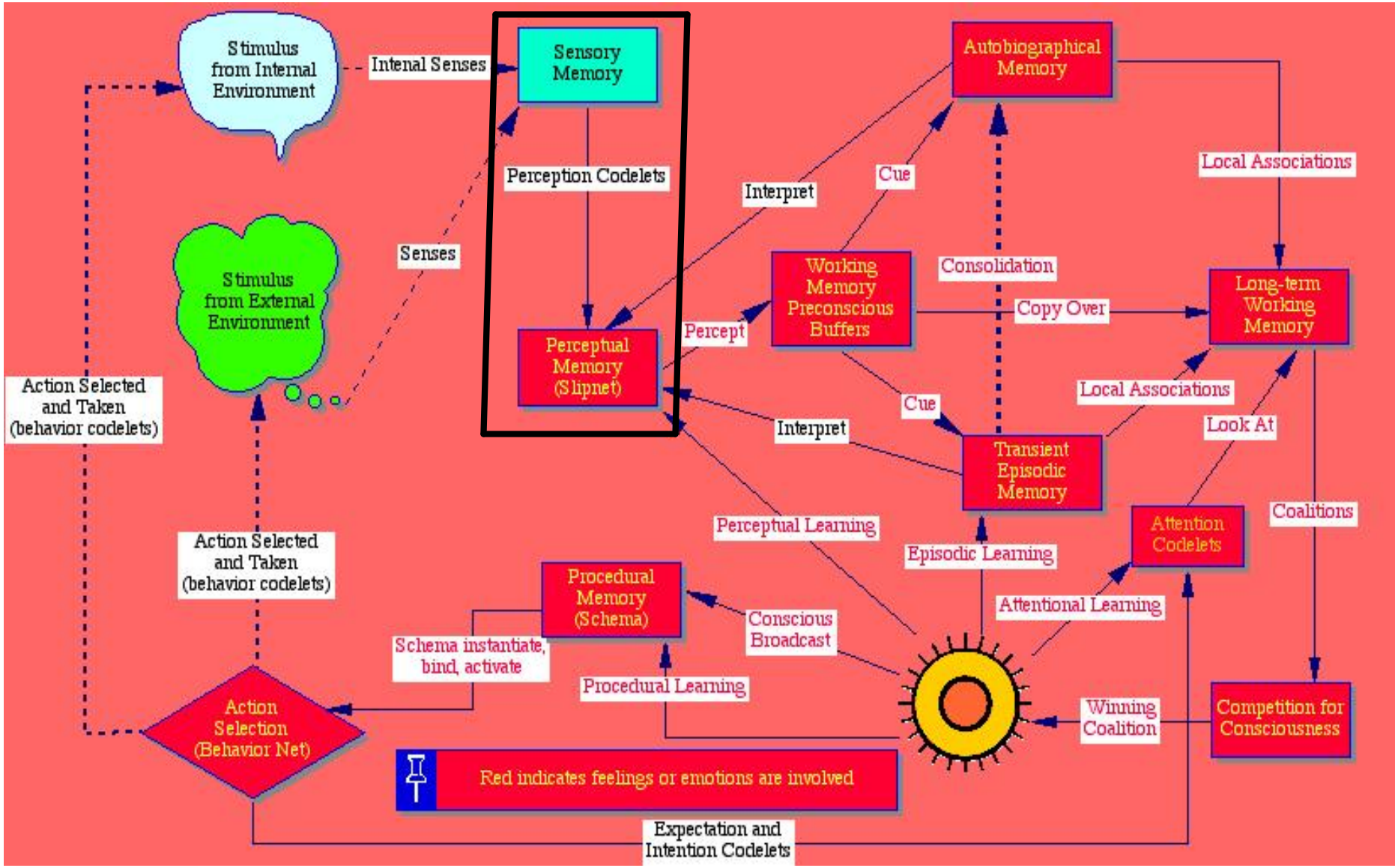
Sensation

- Sensory receptors are directed by action
  - Saccades of the eyes
  - Sniff
  - Turing of an ear
  - Sending of an echolocation signal
- The environment impinges on receptors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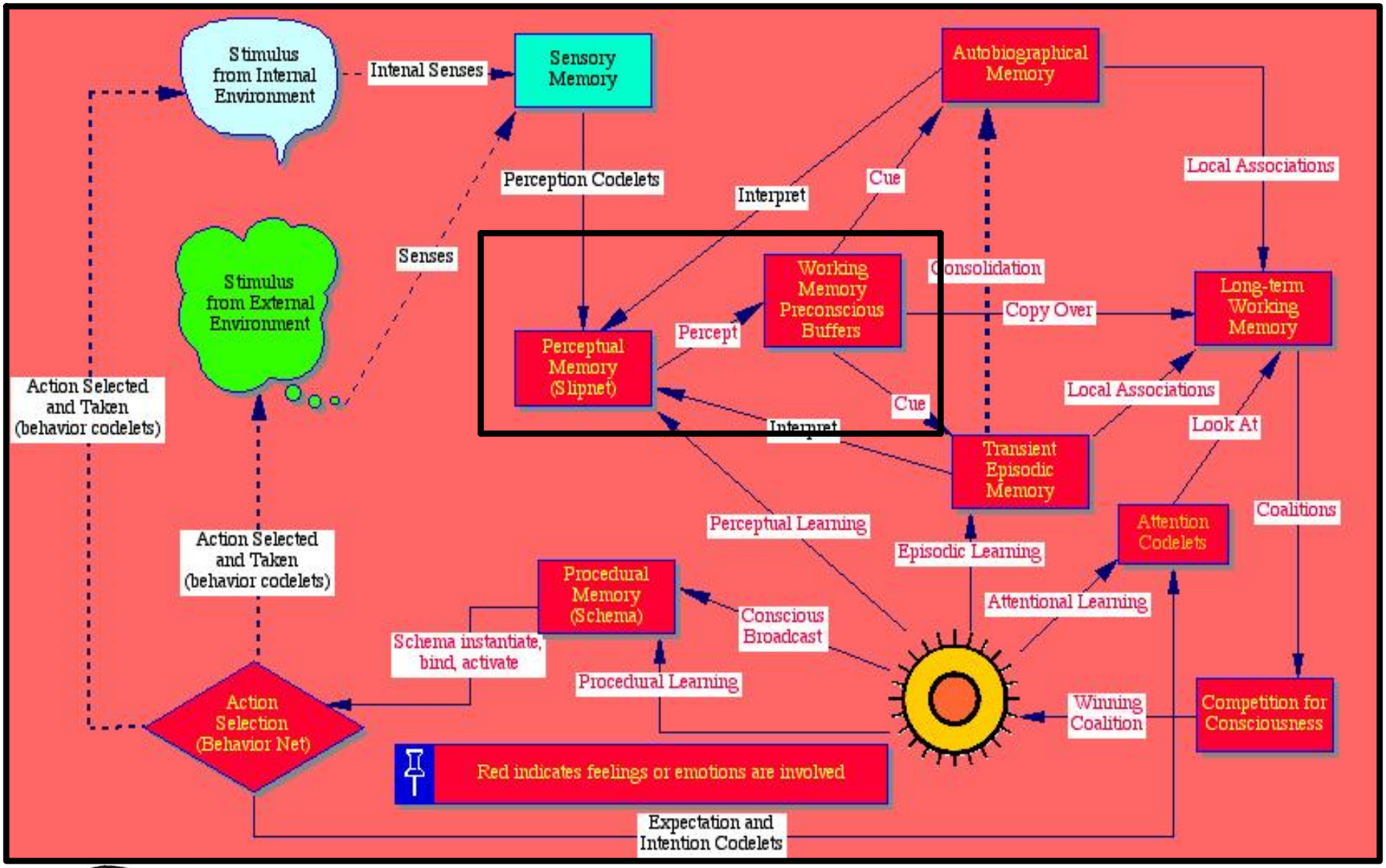
Perception

- Filters sensory input based on expectation
- Simultaneously attaches meaning to it
- Identifies individuals, categories, relations and feelings
- Produces a percept including individuals, categories, relations, ideas, and some interpreted sensory data, i.e, qualia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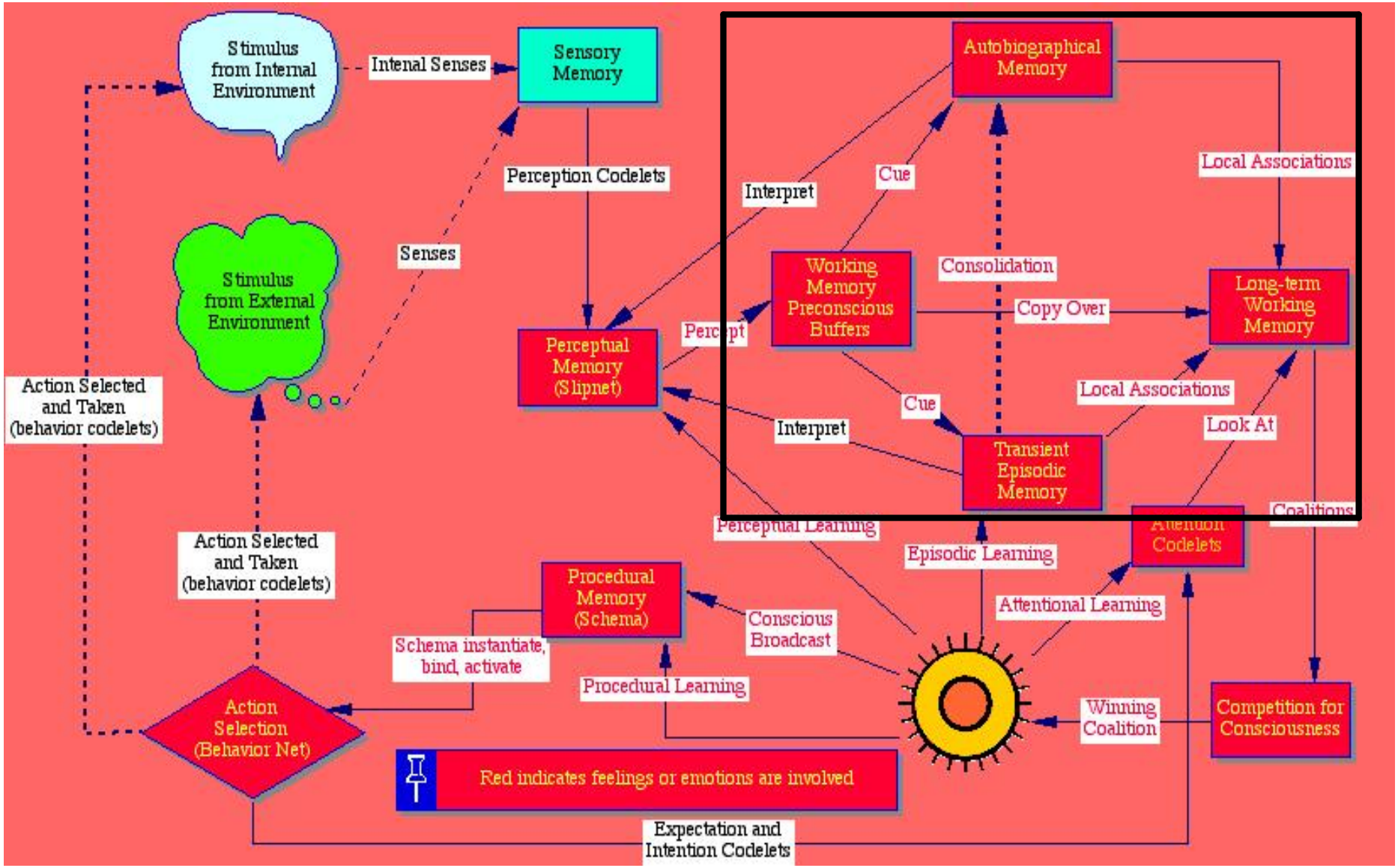
Percept to Working Memory

- Preconscious working memory buffers
- One for each sensory modality (?)
- One for binding (? Controversial–may occur during perception)
- Decays over a relatively few cycles (a few tens of seconds in humans)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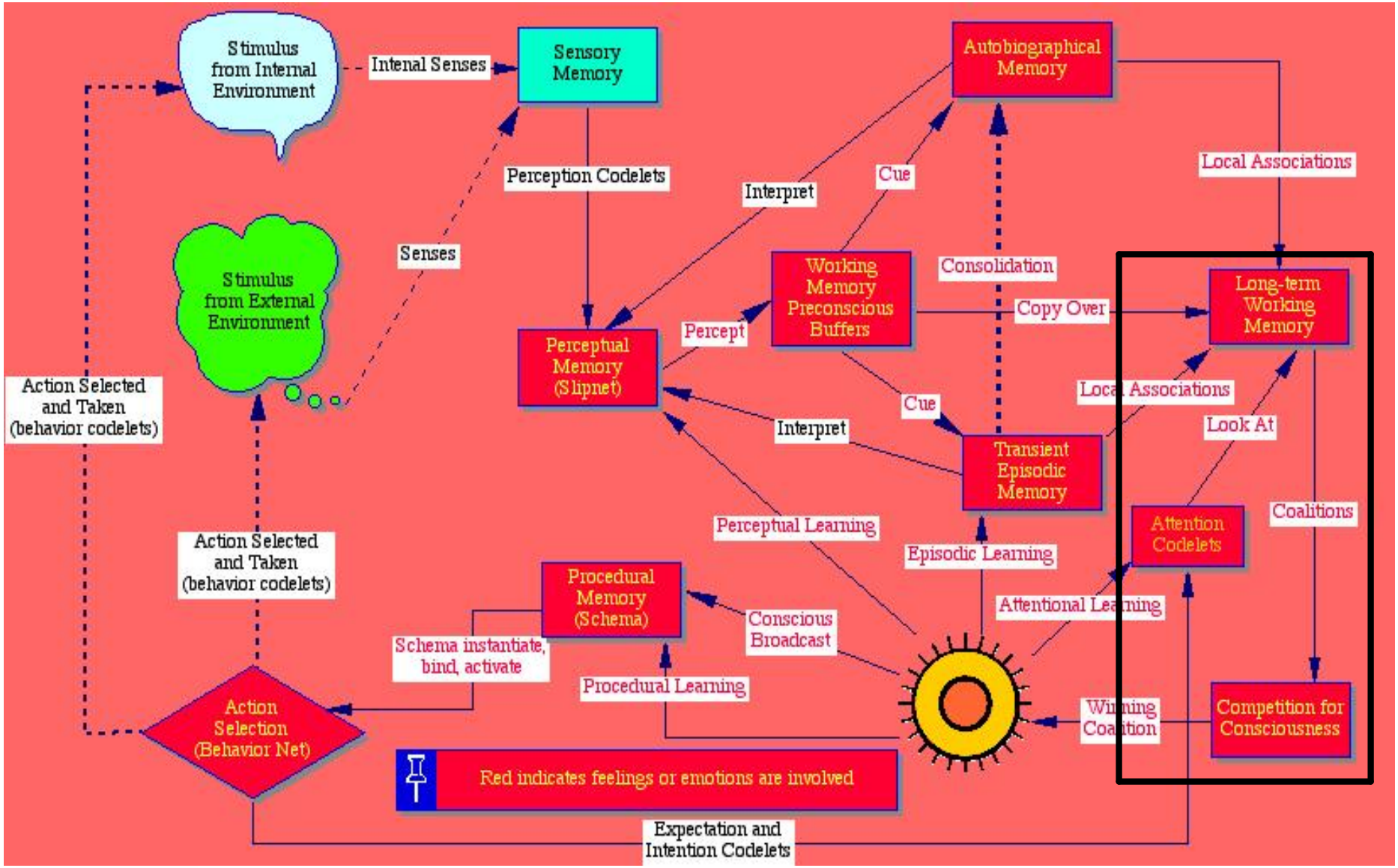
Local Associations

- Working memory contents cue
  - Transient episodic memory
  - Declarative memory
- Produces local associations in long-term working memory
- Including prior feelings and actions
- Long-term WM includes WM
- Working memory = long-term WM?

Codelets

- Small pieces of code each performing a simple, specialized task
- Often waits as a demon, watching for a chance to act
- Implement processors from Global Workspace theory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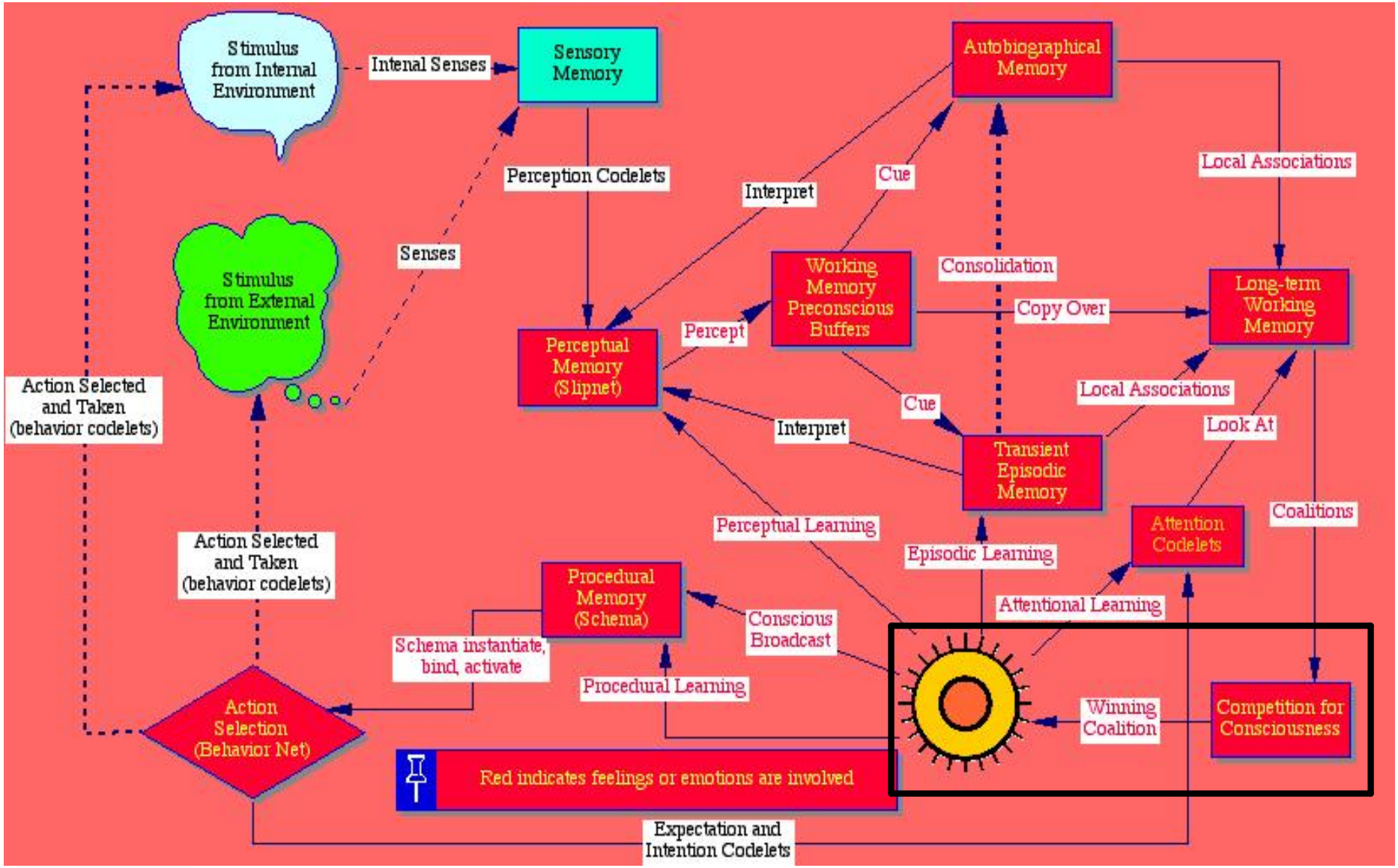
Competition for Consciousness

- Attention—process of bringing to consciousness
- Looking at L-TWM, attention codelets form coalitions with information codelets
- Coalitions compete for consciousness
- Relevance, importance, urgency, insistence, etc., measured by affect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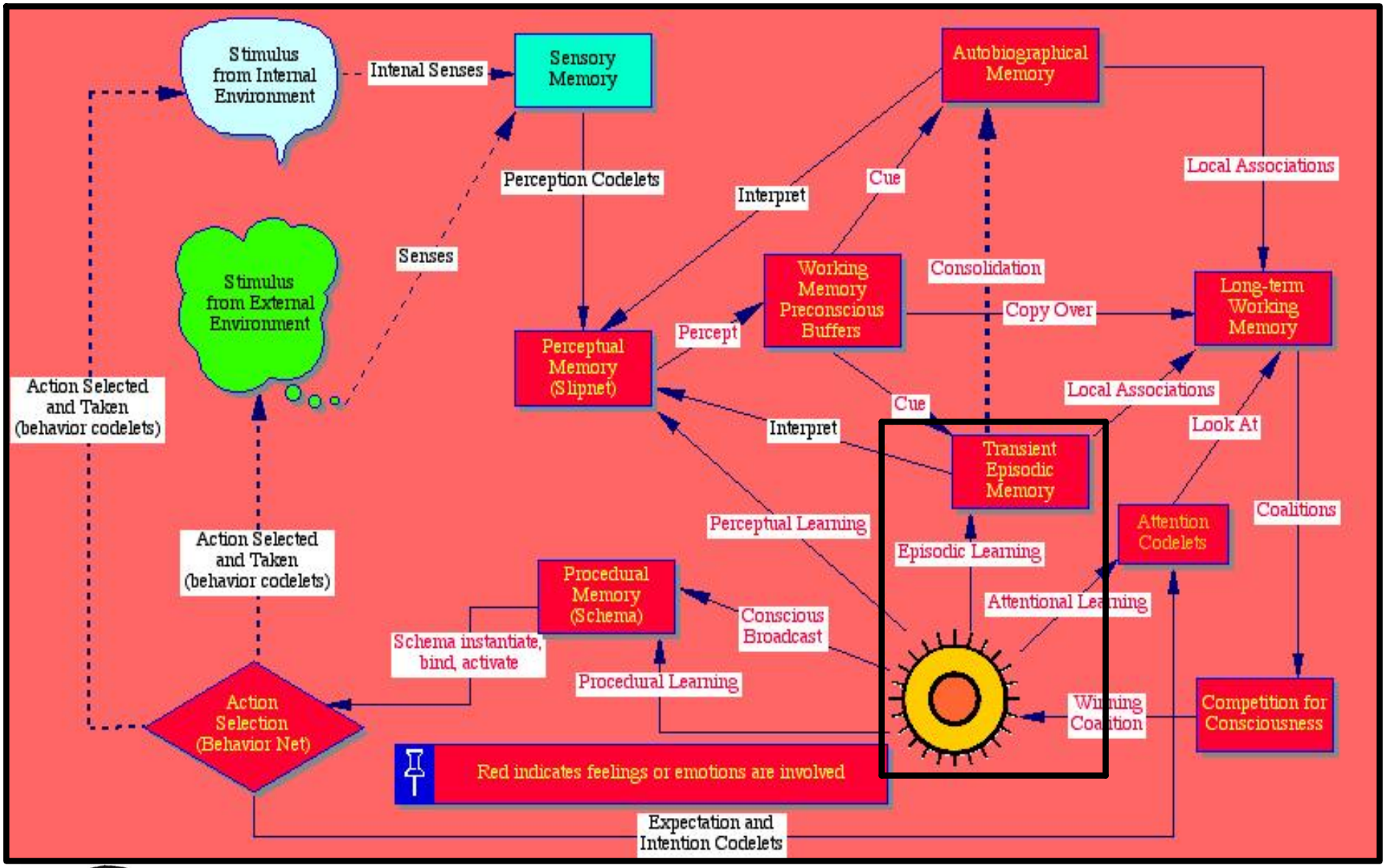
Conscious Broadcast

- Winning coalition of codelets occupies the Global Workspace (a tautology)
- The contents of Global Workspace are broadcast to every codelet
- The result is learning of several kinds, and the recruitment of resources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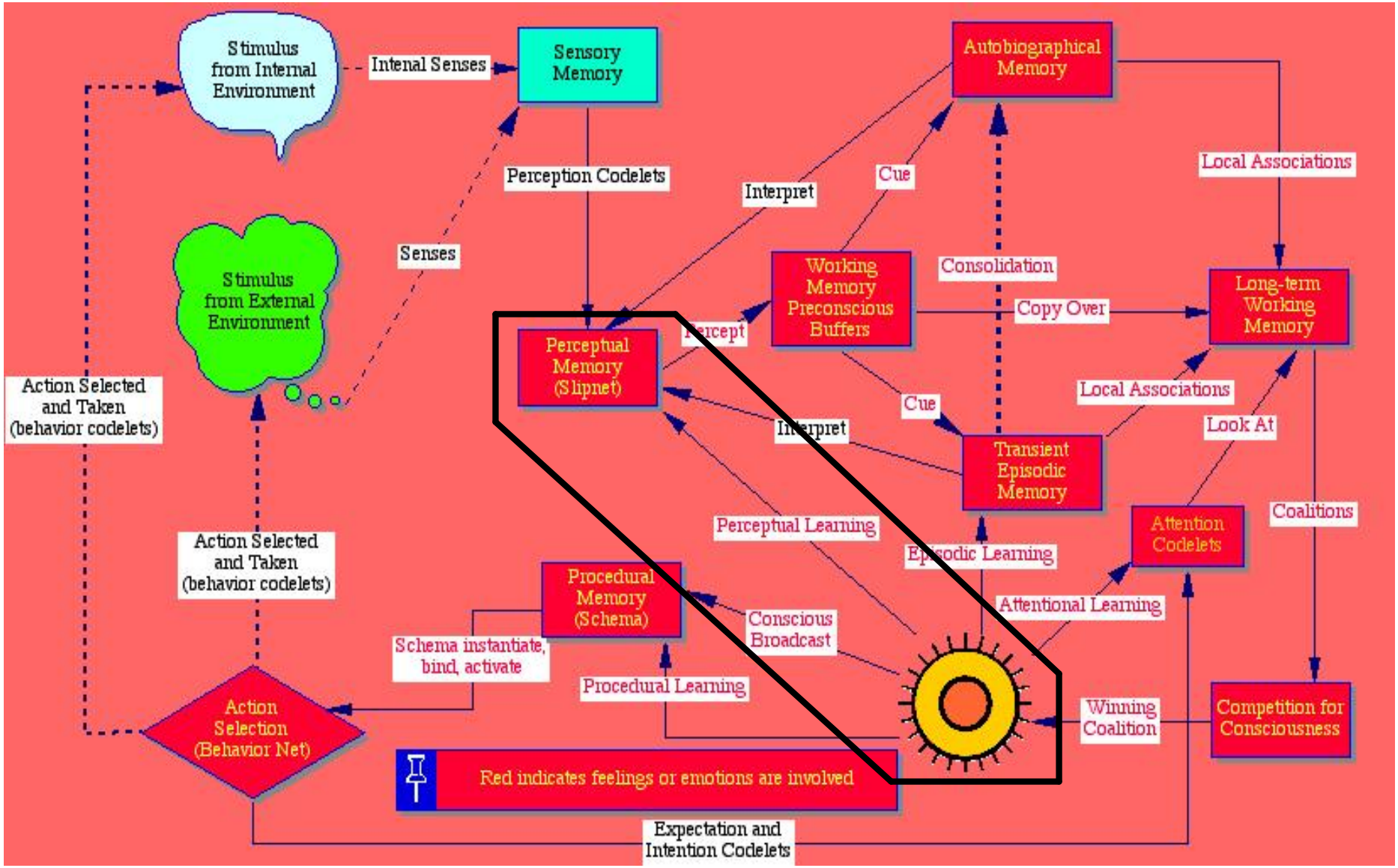
Episodic Learning

- Encoding of conscious contents in Transient Episodic Memory
- As events — what, when and where
- Includes current feelings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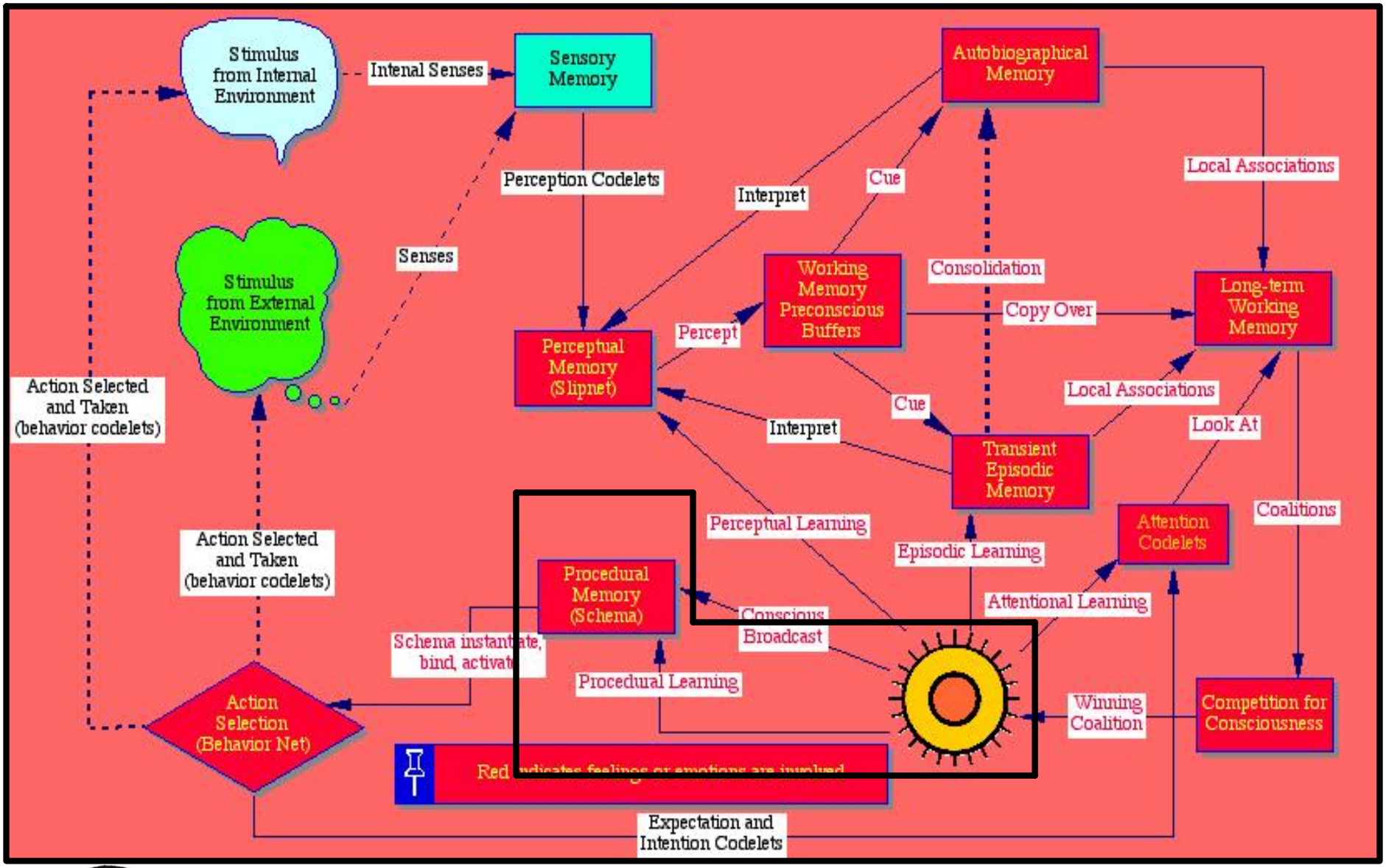
Perceptual Learning

- Using the broadcast contents of consciousness
- Strengthen (or weaken) existing objects, categories, ideas, relations, feelings, etc.
- Create new objects, categories, relations,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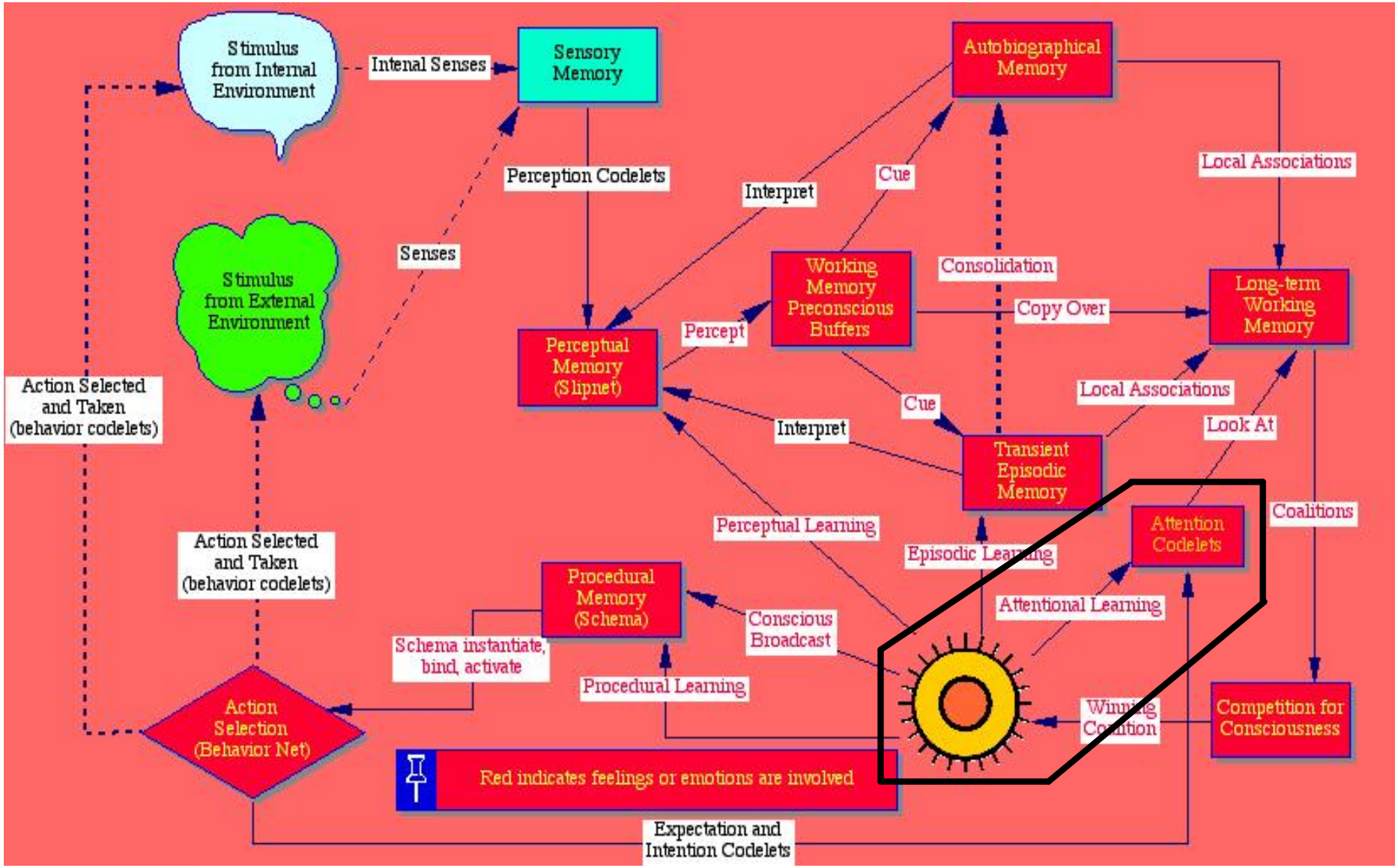
Procedural Learning

- Using the contents of consciousness
- Reinforce those schema that were successful in recently prior acts
- Amount and valence of reinforcement depends on arousal level and degree of success
- Learn new parallel and sequential schema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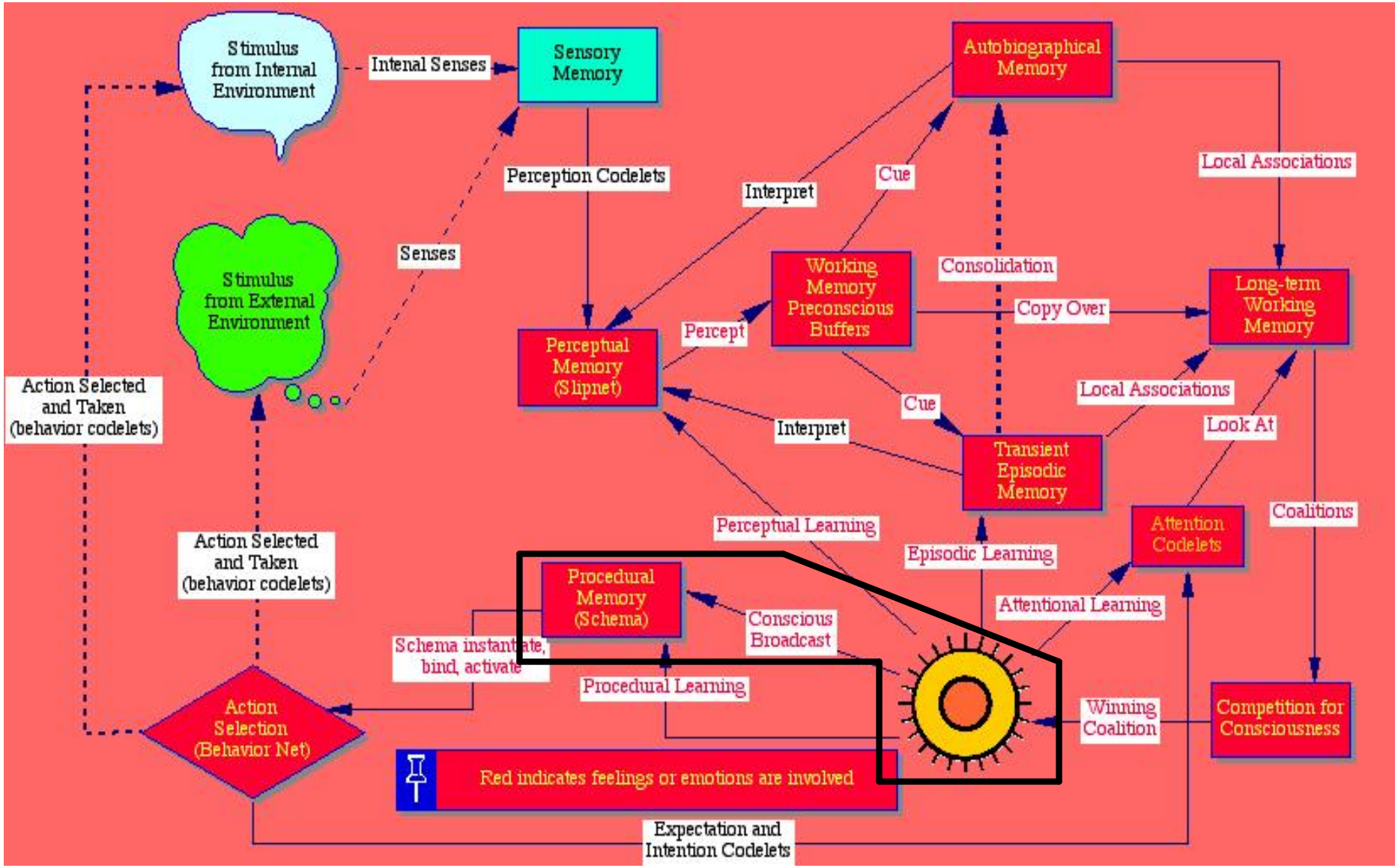
Attentional Learning

- Successful attention codelets are reinforced
- New attention codelets are created as needed

Behaviors & Behavior Streams

- Behavior—a coalition of behavior codelets (goal contexts)
- Underlying behavior codelets can accomplish the goal
- Behavior stream—a stream of related behaviors (goal context hierarchies), best thought of as partial plans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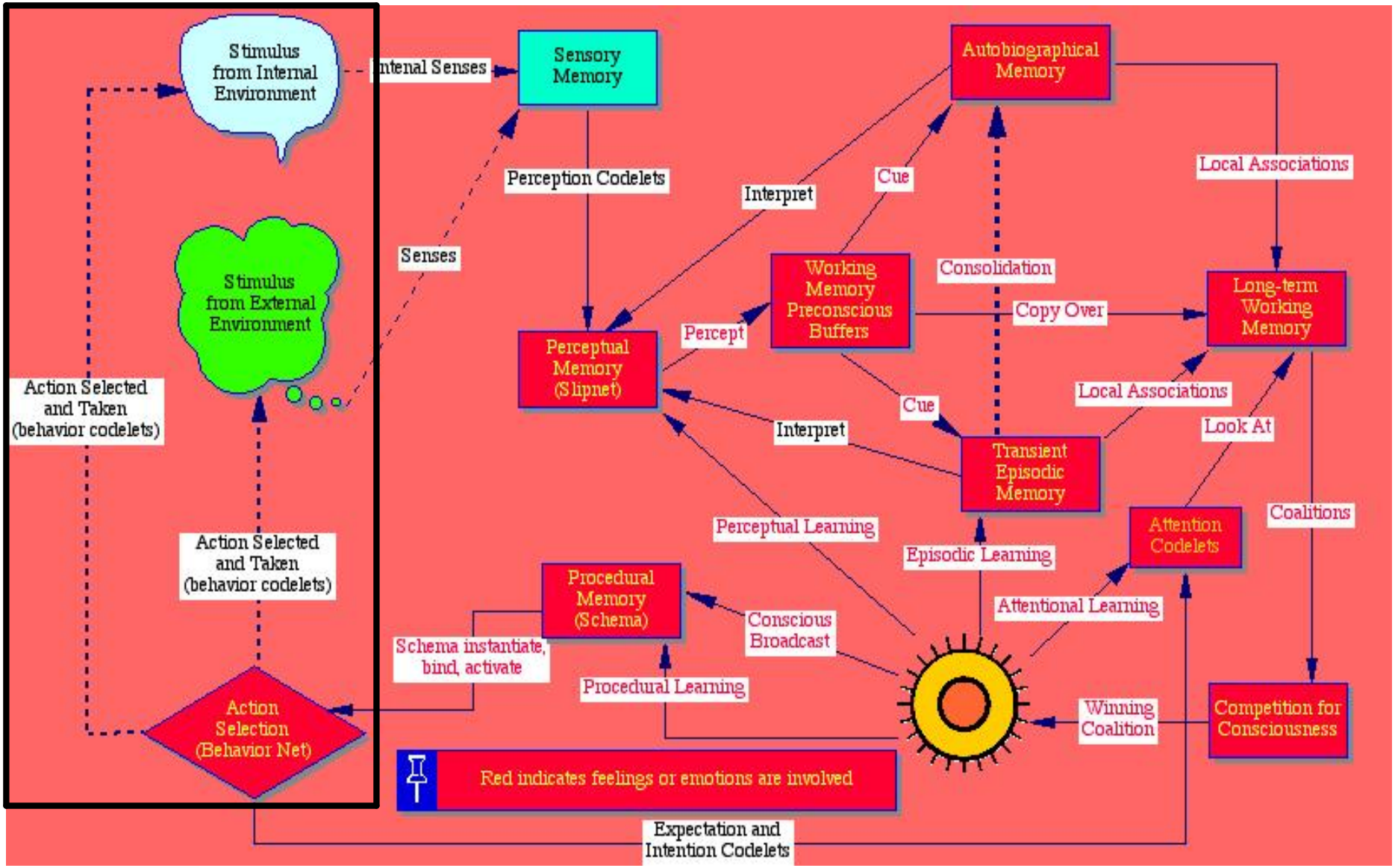
Recruitment of Resources

- Behavior codelets in priming mode respond to specific contents and
  - Instantiate behavior streams
  - Bind variable in behaviors
  - Allocate environmental activation
  - Allocate motivational activation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Action Selection & Action

- IDA's behavior net chooses among competing behavior in competing streams
- A single behavior is chosen
- Its underlying behavior codelets perform their tasks—IDA's action during that cycle
- The internal or external environment is affected

Readings

- Read about Global Workspace Theory in
  - Baars, B. J. 1997. *In the Theater of Consciousness*. Oxford: Oxford University Press.
- Read about IDA's Cognitive Cycle in
  - Baars, B. J., and S. Franklin. 2003. How conscious experience and working memory interact. *Trends in Cognitive Science* 7:166-172.

Email and Web Addresses

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