The enactive perception debate

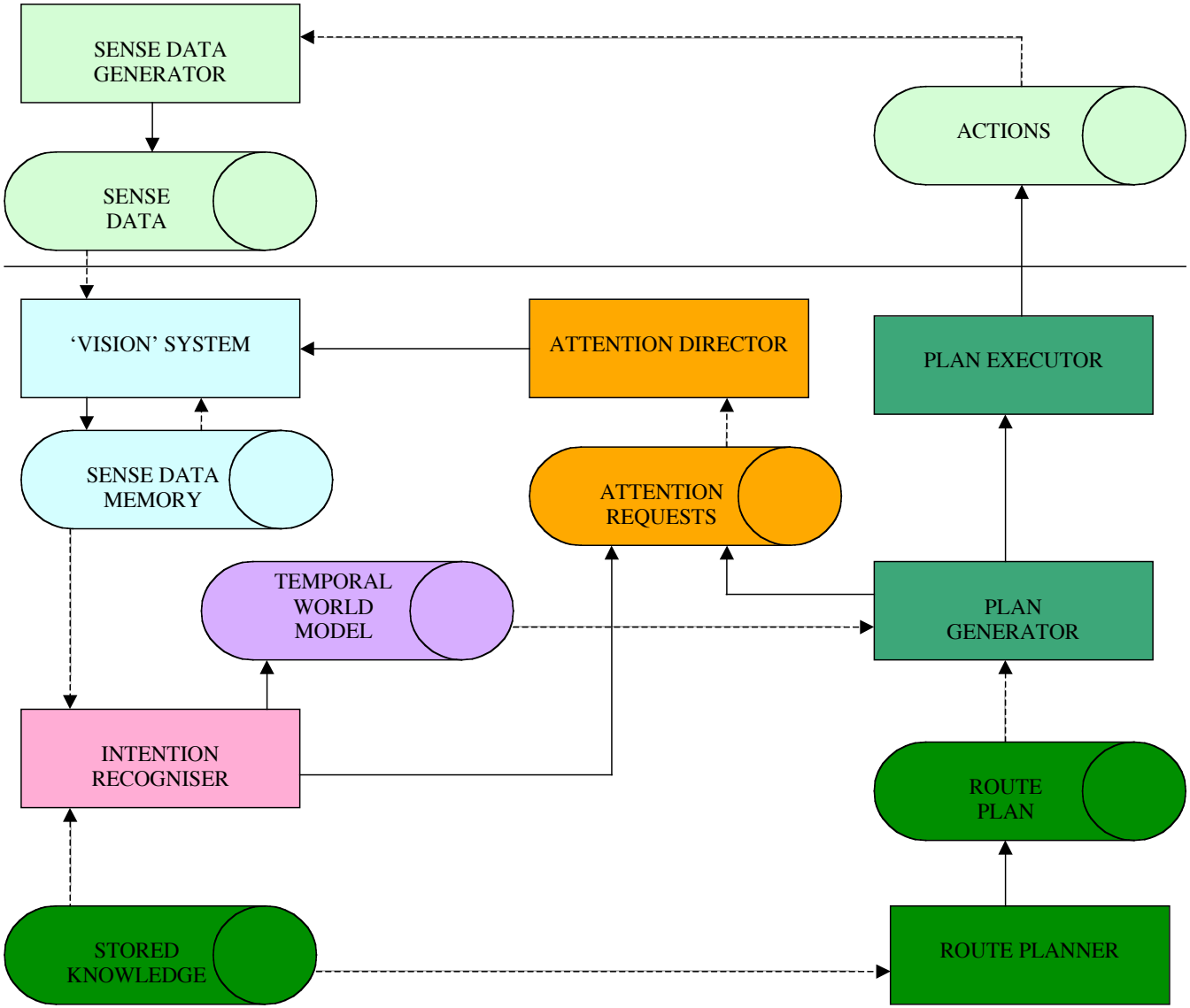
- Context of sensorimotor activity
- Rensink and the focus of attention
- Active indexing to visual world
- Just-in-time scene/object representations
- The status of ‘representations’

Focus of presentation

- Two issues concerning an agent's interactions with the world which appear to be relevant to this discussion
- Ability to predict, anticipate, change expectations and apply knowledge to reasoning
- That attention is directed towards what an agent wants or needs to know

Background

- Situated, embodied, computational agent(s) in a simulated driving world (AUTODRIVE)
- Task domain a real-time, ‘dynamic’ multi-agent environment: decision-making testbed
- Sense data necessary but not sufficient?
- Experiments with TouringMachines (Ferguson, 1992)


SENSE DATA GENERATOR
SENSE DATA
ACTIONS
'VISION' SYSTEM
ATTENTION DIRECTOR
PLAN EXECUTOR
SENSE DATA MEMORY
ATTENTION REQUESTS
TEMPORAL WORLD MODEL
PLAN GENERATOR
INTENTION RECOGNISER
ROUTE PLAN
STORED KNOWLEDGE
ROUTE PLANNER

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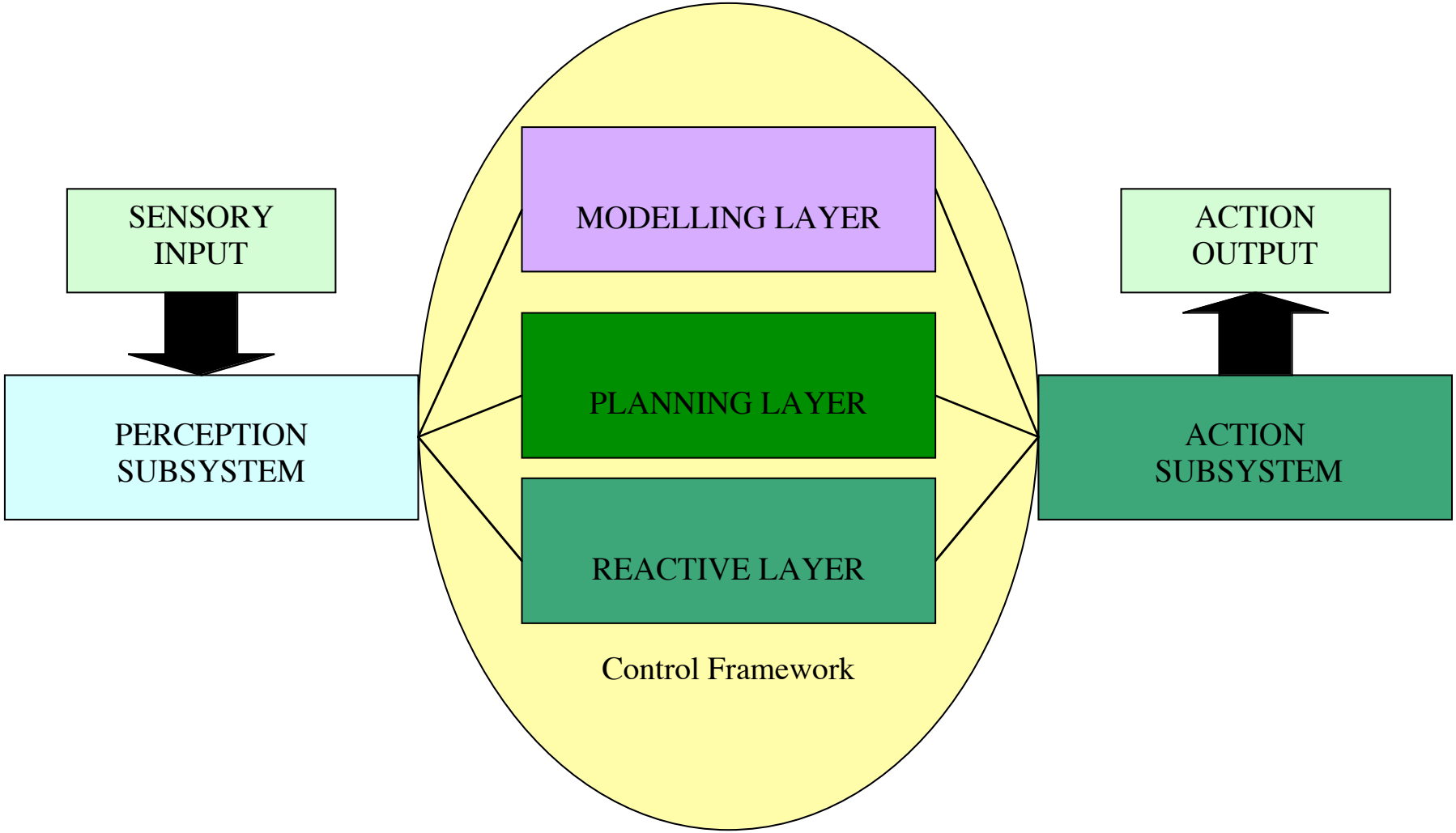
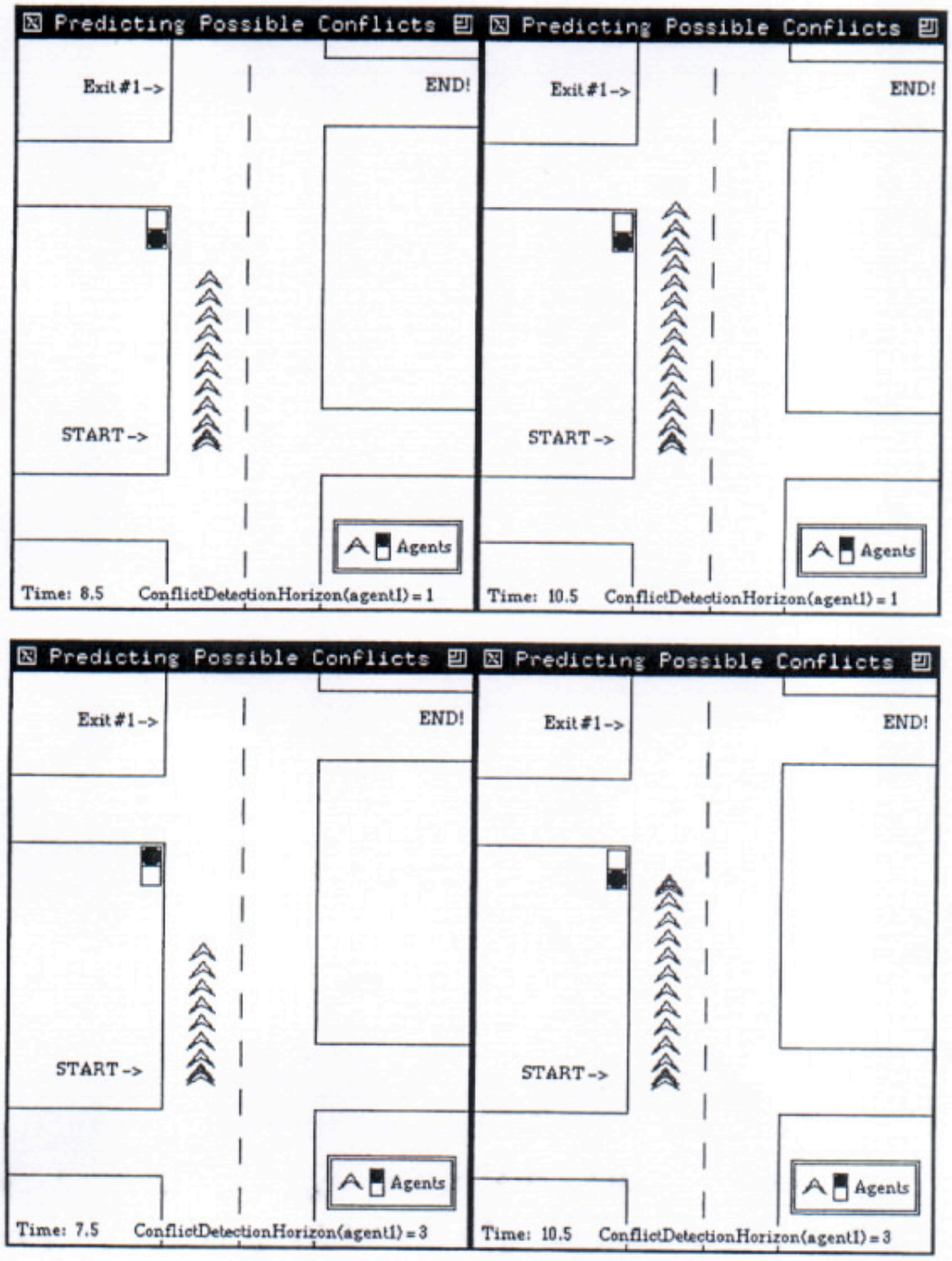
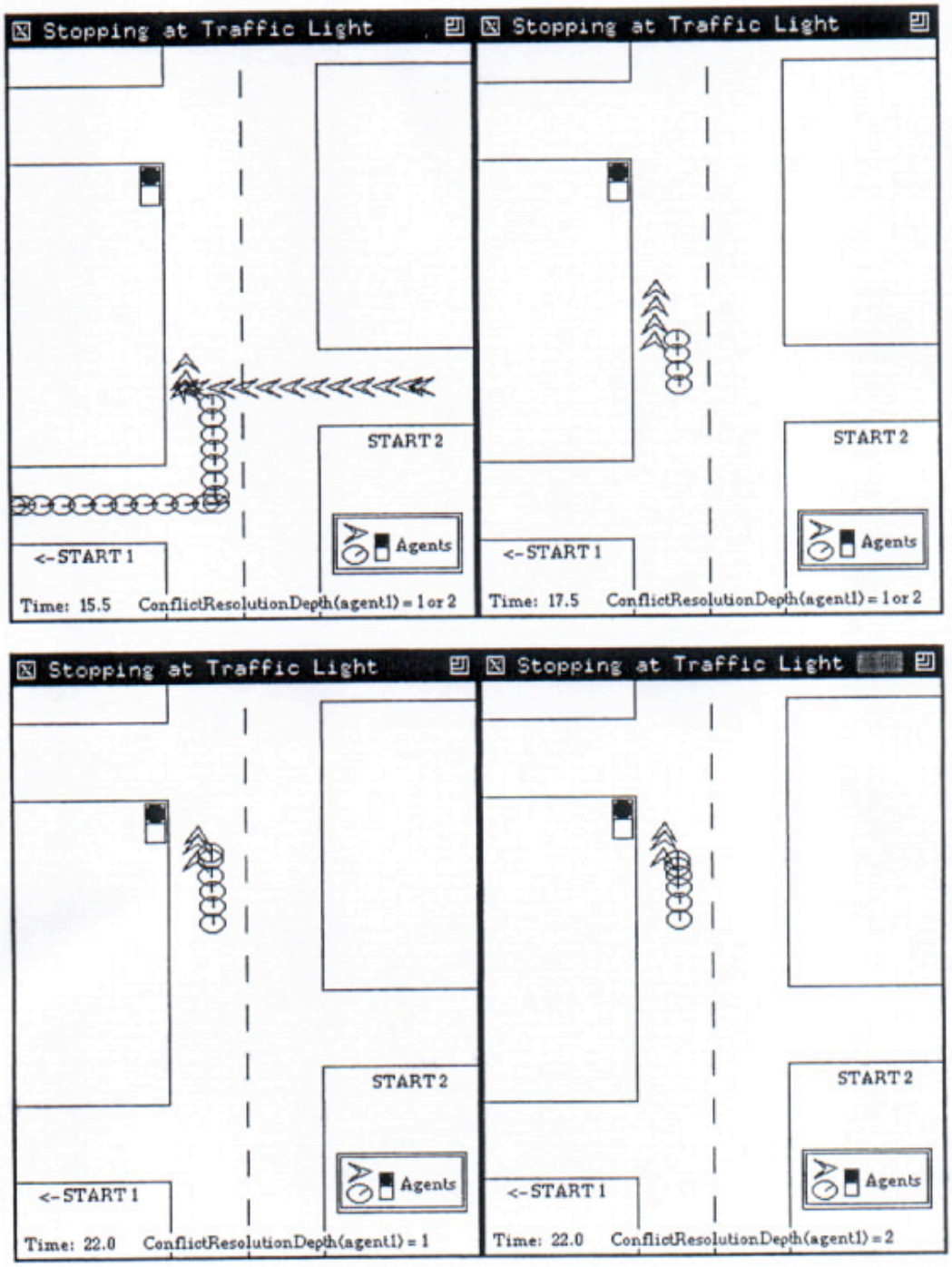

SENSORY
INPUT
PERCEPTION
SUBSYSTEM
MODELLING LAYER
PLANNING LAYER
REACTIVE LAYER
Control Framework
ACTION
OUTPUT
ACTION
SUBSYSTEM


Predicting Possible Conflicts
Exit #1 ->
END!
START ->
Agents
Time: 8.5
ConflictDetectionHorizon(agent1) = 1
Predicting Possible Conflicts
Exit #1 ->
END!
START ->
Agents
Time: 10.5
ConflictDetectionHorizon(agent1) = 1
Predicting Possible Conflicts
Exit #1 ->
END!
START ->
Agents
Time: 7.5
ConflictDetectionHorizon(agent1) = 3
Predicting Possible Conflicts
Exit #1 ->
END!
START ->
Agents
Time: 10.5
ConflictDetectionHorizon(agent1) = 3


Stopping at Traffic Light
START 2
Agents
<-START 1
Time: 15.5 ConflictResolutionDepth(agent1) = 1 or 2
Stopping at Traffic Light
START 2
Agents
<-START 1
Time: 17.5 ConflictResolutionDepth(agent1) = 1 or 2
Stopping at Traffic Light
START 2
Agents
<-START 1
Time: 22.0 ConflictResolutionDepth(agent1) = 1
Stopping at Traffic Light
START 2
Agents
<-START 1
Time: 22.0 ConflictResolutionDepth(agent1) = 2

Temporal context for sensorimotor contingencies

- Informed action appears to rely on accumulated sense data
- Integration of previously sensed data with current set implies sense data are stored
- Ability to anticipate and modify expectations implies sense data are remembered
- Provides a context for sensorimotor contingencies

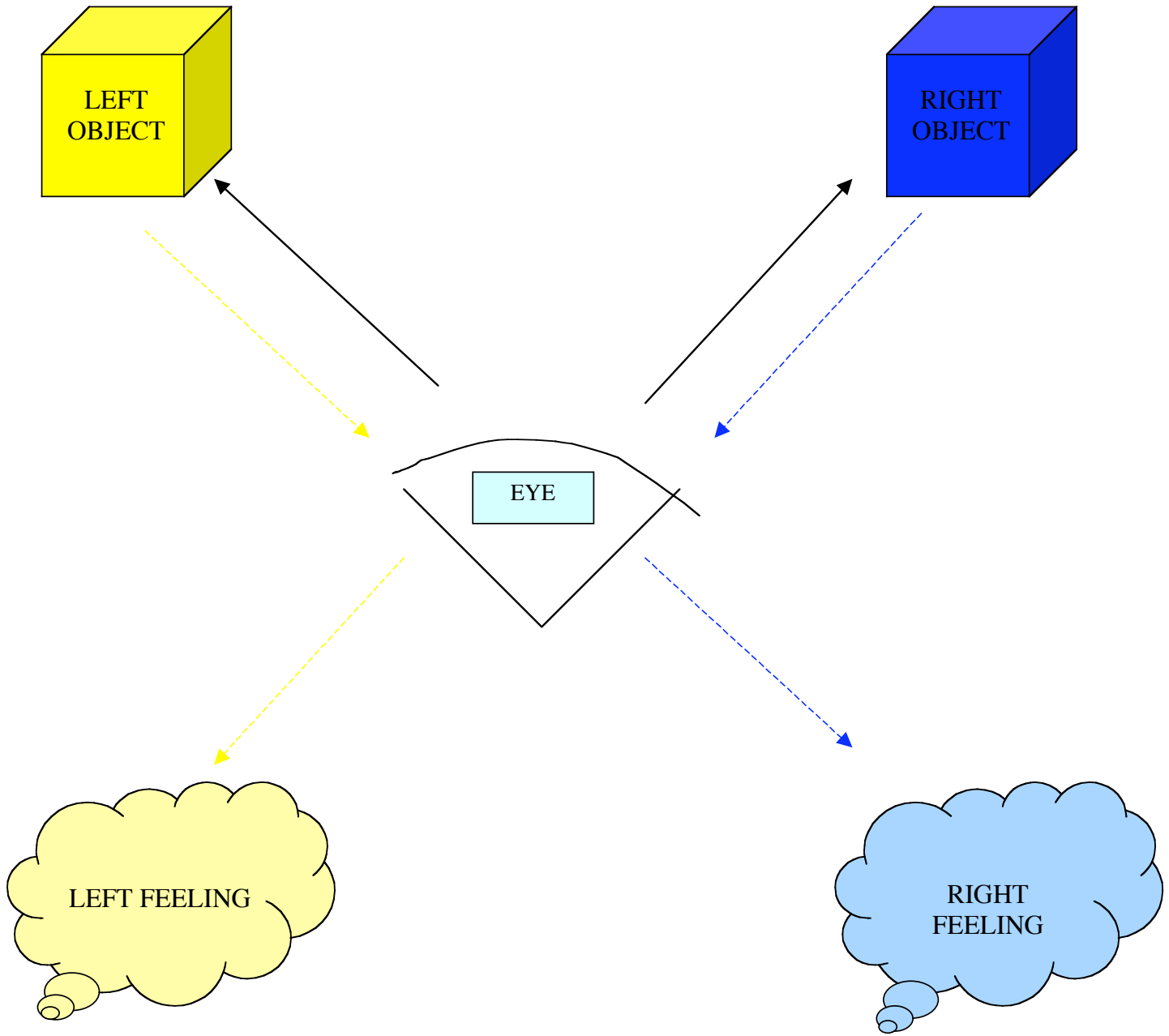
What guides attention?

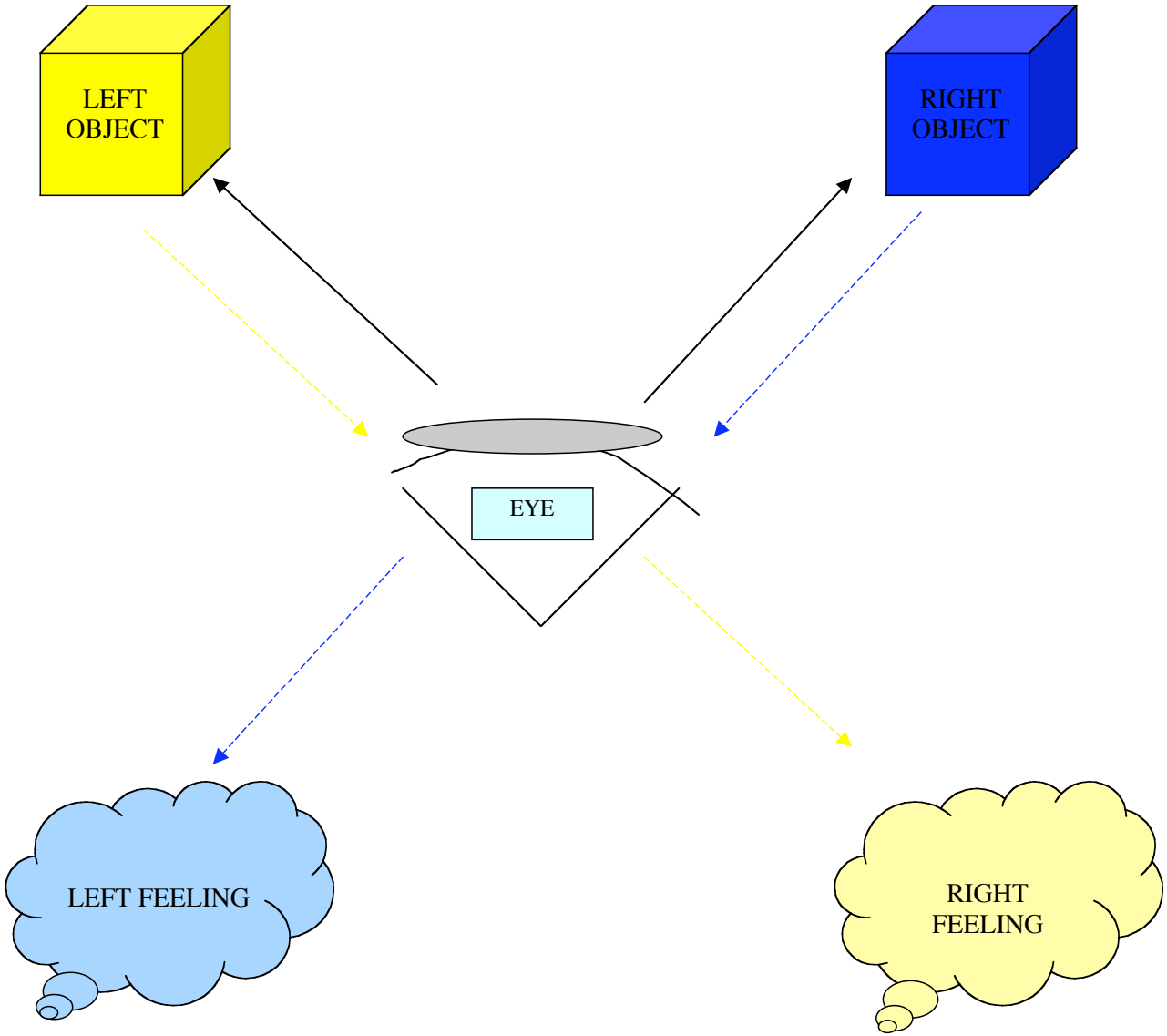
- Knowledge plays a crucial role regarding where to seek information
- Goals determine relevant information
- Situational awareness indicates what information we are lacking
- Rensink's coherence theory of attention

> "..focussed attention provides spatiotemporal coherence for the stable representation of one object at a time……the allocation of attention can be cooridinated to create a "virtual representation"……a stable object representation is formed whenever needed, making it appear to all higher levels as if all objects in the scene are represented in detail simultaneously."
>
> (Rensink, 2000, Abstract, p1)

Is this representation?

- Sensorimotor contingencies avoid representation
- ‘Virtual representations’ may do the same
- Evidence for prospective visual behaviours without memory or prediction (Schlesinger & Barto, 1999; Schlesinger & Parisi, 2001)
- Conditions for change in sensorimotor contingencies


LEFT
OBJECT
RIGHT
OBJECT
EYE
LEFT FEELING
RIGHT
FEELING


LEFT
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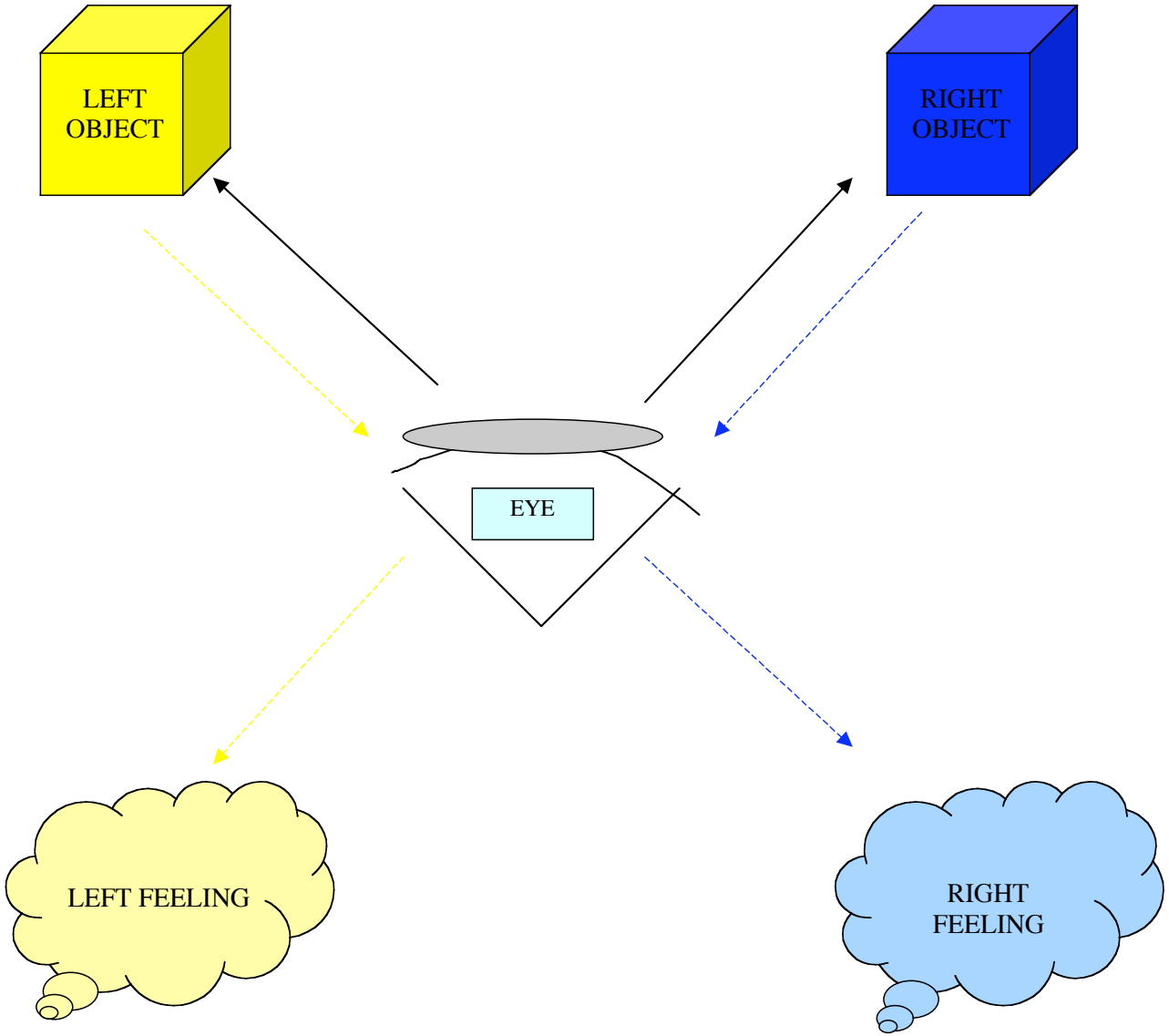
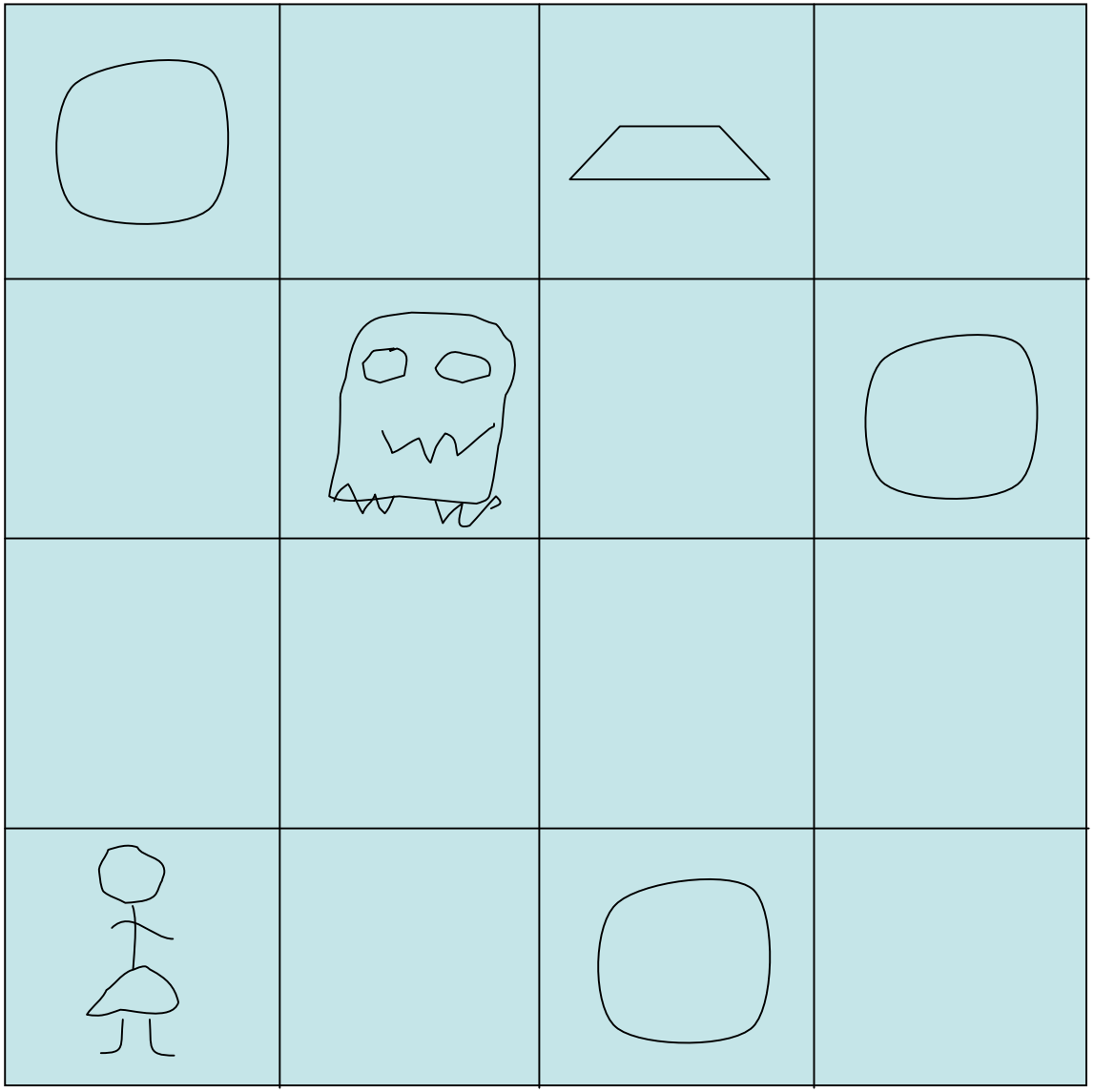
RIGHT
FEELING


LEFT
OBJECT
RIGHT
OBJECT
EYE
LEFT FEELING
RIGHT
FEELING

Anticipation and Attention

- Contradictory sensori-motor contingencies basis for change
- Dependent on the sensory modality through which they arise cf. O'Regan & Noe
- Are revoked anticipations merely inconsistent sensorimotor contingencies?



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- Rensink's triadic architecture offers a framework for combining what is learned with what is observed through attention
- The need for up-to-date data may guide this mapping
- Consistency seems to be important for sensorimotor contingencies
- Is attention invoked by a drive for consistency in sensorimotor contingencies?

References

- Ferguson, I. (1992) *TouringMachines: An architecture for dynamic, rational, mobile agents*. TR Report No. 273, Computer Laboratory, University of Cambridge.
- O'Regan, K. & Noe, A. (2001) A sensorimotor account of vision and visual consciousness. *Behavioural and Brain Sciences*, 24, 939-1031.
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- Schlesinger, M. and Barto, A. (1999) Optimal control methods for simulating the perception of causality in young infants. In M.Hahn & S.C. Stoness (Eds) *Proceedings 21st Conference of the Cognitive Science Society,* Erlbaum.
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- Wood, S. (1995) When being reactive just won't do. In *Proceedings of Workshop on Integrated Planning Applications*, AAAI Spring Symposium, Stanford University, Palo Alto, CA, March 27-29 1995, 102-106.