



A Cognitive Architecture Theory of Comprehension and Appraisal: Unifying Cognitive Functions and Appraisal

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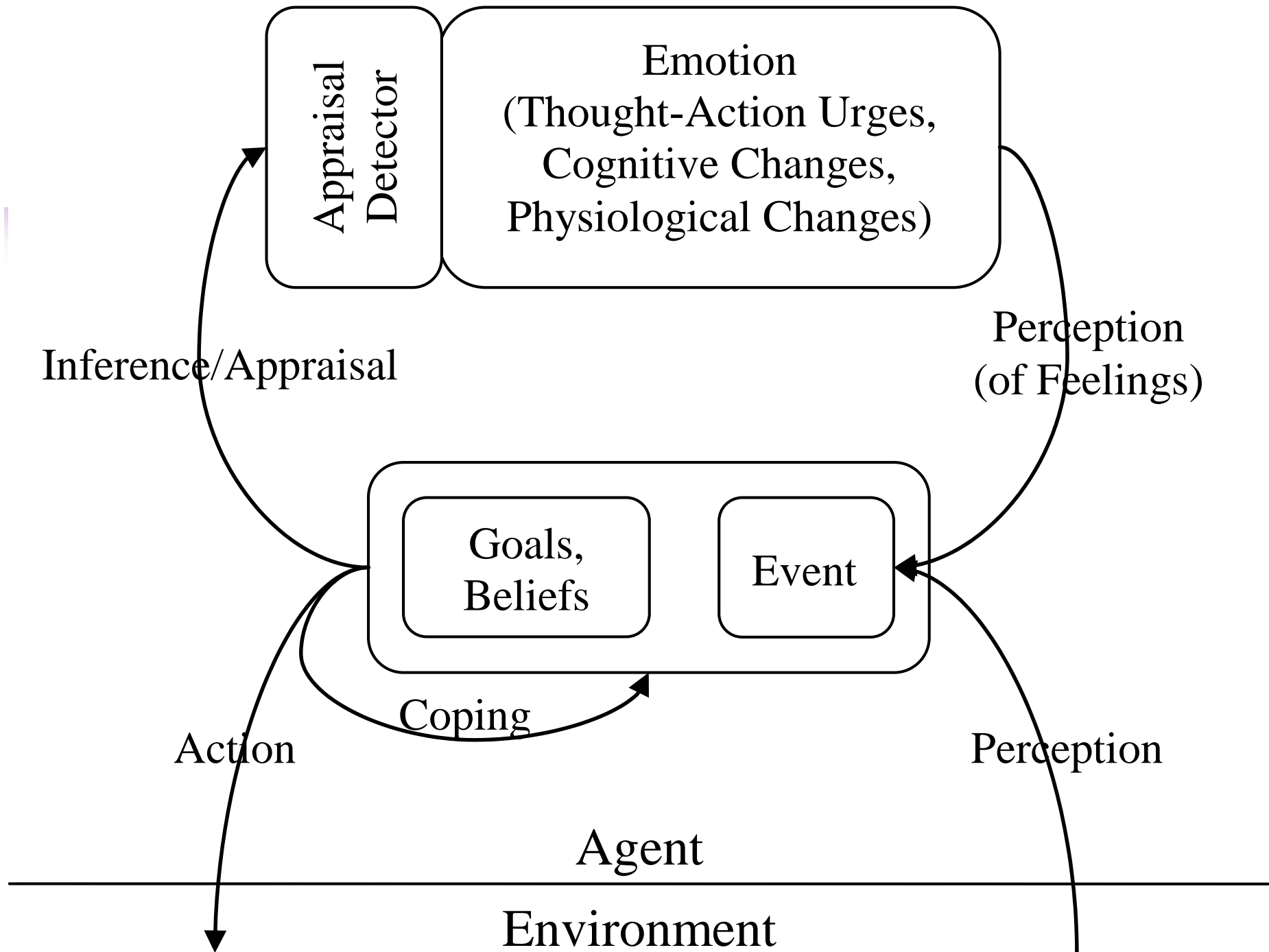
Overview

- Introduction
- Emotion Process
- Cognitive Functions
- Unification



Introduction

- Have independent theories of emotion and cognitive functions
 - Emotion: Appraisal Theory
 - Cognitive Functions: Allen Newell's PEACTION
- Each of these is incomplete
- Emotion and cognition are tightly integrated in humans via appraisal
- How can we unify cognitive functions with appraisal?





What's missing?

- When are appraisals generated?
- Why are the appraisals generated then?
- How are appraisals generated?
- How do appraisal and emotion impact behavior (in detail)?

Cognitive Functions: Allen Newell's PEACTION

An agent must be able to perform the following functions

Event Processing	Perceive	Raw perception
	Encode	Create domain-independent representation
	Attend	Chose stimulus to process
	Comprehend	Generate structures that relate stimulus to goals and can be used to inform behavior
Response Processing	Tasking	Perform goal maintenance
	Intend	Chose an action
	Decode	Decompose action into motor commands
	Motor	Execute motor commands



What's missing?

- What does Encode generate?
- How does Attend pick a stimulus?
- What does Comprehend generate?
- How does Tasking work (e.g. what information does it require?)

Unifying Cognitive Functions and Appraisal

Event Processing

Perceive	Raw perception
Encode	Domain-independent representation
Attend	Chose stimulus to process
Comprehend	Generate structures that relate stimulus to goals and can be used to inform behavior
Tasking	Perform goal maintenance
Intend	Chose an action

Appraisal
Generators

Appraisal
Consumers



Event Processing: Desirable Properties

- Domain independent
- Limited working memory
- Happens over time
- Incremental
- Supports immediate comprehension
- Supports hierarchical comprehension
- Supports prediction
- Influenced by external processes



Encode and Event Structure

- Encode generates domain-independent structures from the raw Perceptual information
 - Fast, parallel process
- Possible structure
 - Simplification of Talmy (1975)
 - Actor **Bob**
 - Action **Walking across street**
- Also includes Novelty information (e.g. is this a common event, did it occurred suddenly, etc)



Attend

- Multiple events may occur simultaneously, all of which are Encoded
- Attend uses Novelty information from Encoded structure to pick one to Comprehend next



Comprehension Process

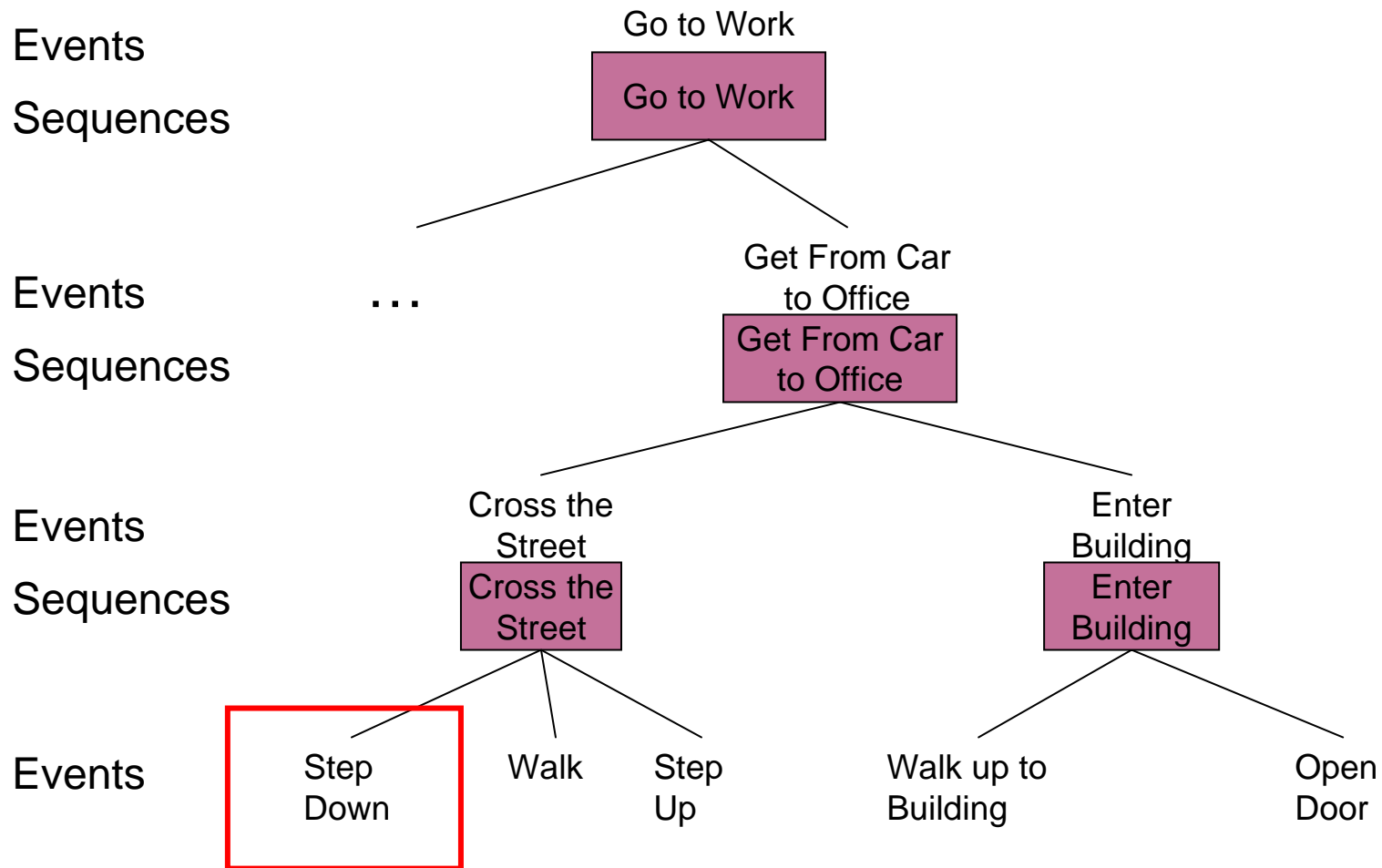
- Goal: To create data structures that inform behavior
- Key: Process *sequences* of events
- Process
 - Observe some sequence of events
 - Match partial sequence to known complete sequence
 - Use complete sequence to predict next event
- Only work on one event or sequence at a time (i.e. processing is local)
- Since the event structures are domain independent, this process is also domain independent



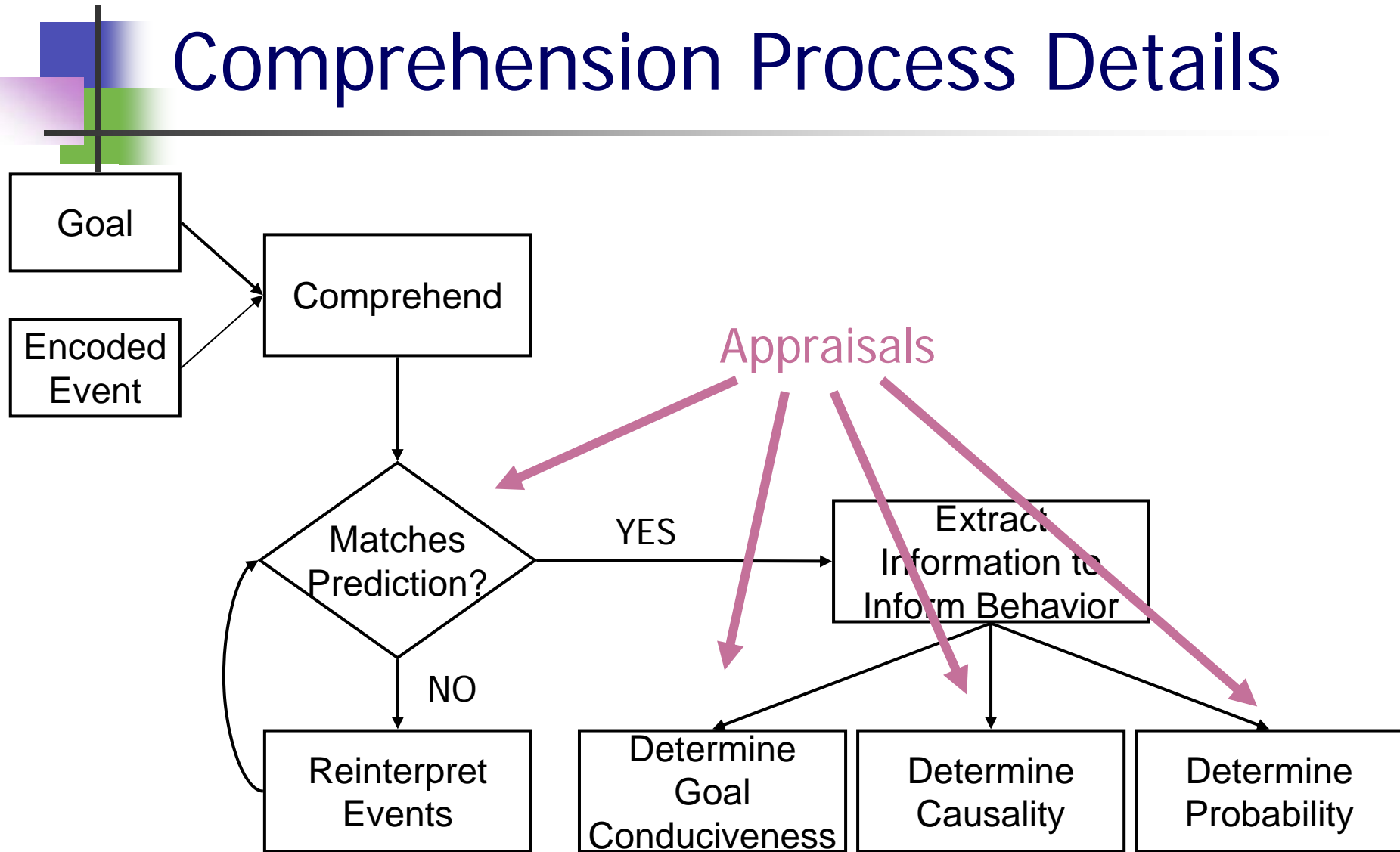
Abstract Events, Sequences and Subgoals

- An event sequence can be abstracted to represent a single event in a more abstract sequence
- Example:
 - Step down from curb
 - Take a few steps
 - Step up onto curb
 - ...this is just the “Cross the Street” event, which may be just one event in the “Get from Car to Office” sequence, which may be one event in the “Go to Work” sequence...which may be just one event in the “Living My Life” sequence.
- Abstract events can be thought of as subgoals

Event Knowledge Hierarchy



Comprehension Process Details

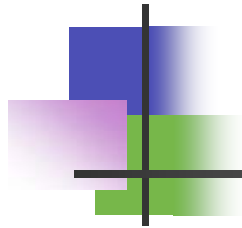




Event Processing: Desirable Properties Revisited

Domain independent	Events are domain-independent
Limited working memory	One interpretation at a time
Happens over time	Events occur over time
Incremental	Attend to one event at a time; Local processing
Supports immediate comprehension	Can always guess at complete sequence based on event
Supports hierarchical comprehension	Sequences can be abstracted to events
Supports prediction	Next event can be read from guessed complete sequence
Influenced by external processes	Ambiguity resolution can be biased by current goal, emotion, memory activation, etc.

Unifying Cognitive Functions and Appraisal Revisited



Response Processing	Perceive	Raw perception
	Encode	Domain-independent representation
	Attend	Chose stimulus to process
	Comprehend	Generate structures that relate stimulus to goals and can be used to inform behavior
	Tasking	Perform goal maintenance
	Intend	Chose an action

Appraisal
Generators

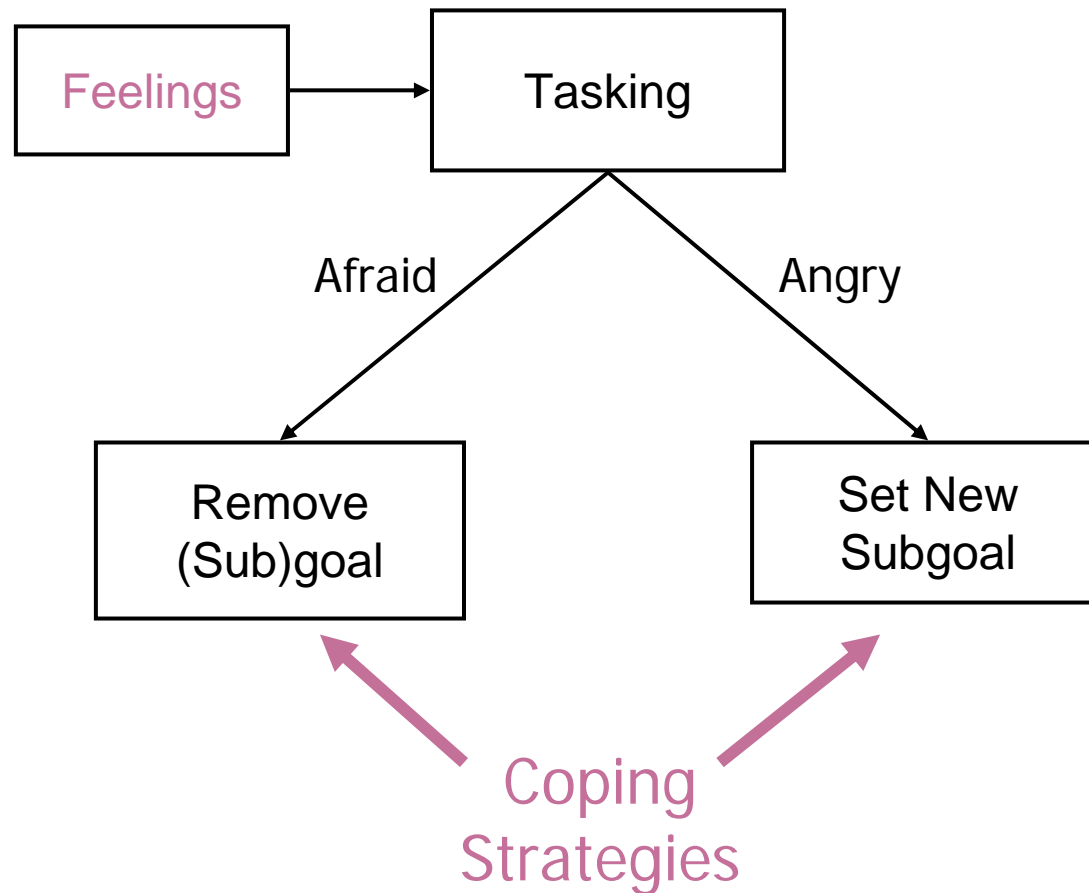
Appraisal
Consumers



Tasking Process

- Goal: Update current (sub)goals as necessary
- Key: Emotion automatically signals with status (goal threatened, situation alterable) and how to fix it (e.g. whose fault is it, etc)
- Process:
 - Determine how to proceed based on implications of emotion

Tasking Process Details





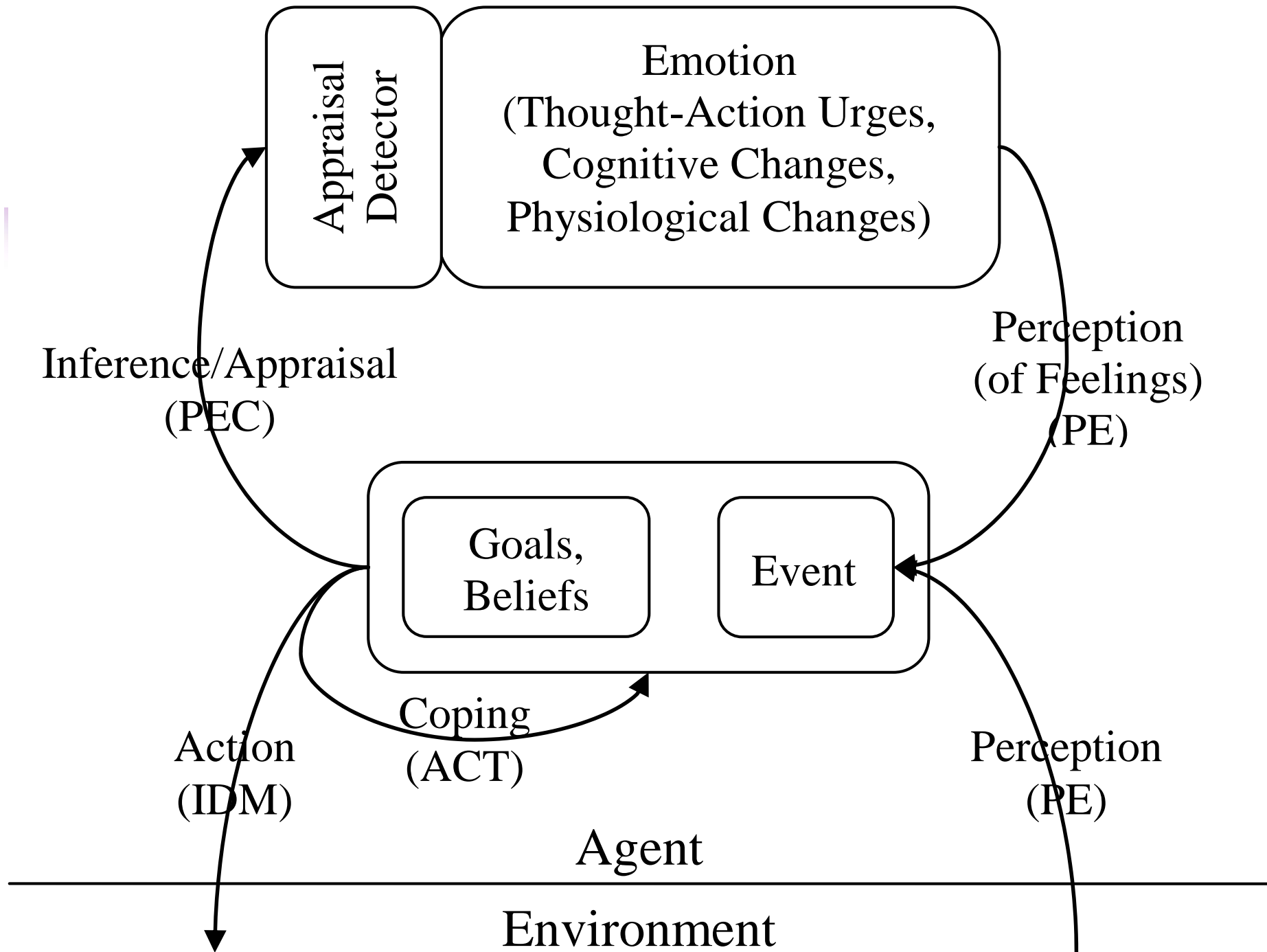
Intend Process

- Goal: Determine next action to execute
- Key: In general, there may be many paths from the current situation to the goal, so Intend must pick one
 - Also has to compete with action tendencies (e.g. automatic responses)
- Process:
 - If urgency is high, “automatic” responses win
 - Otherwise, walk event hierarchy to find path to goal



Unification

Scherer 2001	Generated By	Required By
Novelty: Suddenness	Perception	Attend
Novelty: Familiarity	Encoding	
Novelty: Predictability		
Intrinsic pleasantness	Comprehension	Tasking (via Feelings)
Goal/need relevance		
Cause: agent		
Cause: motive		
Outcome probability		
Urgency		Comprehension
Discrepancy from expectation		
Conduciveness		
Control		
Power		
Adjustment	Tasking (via Feelings)	
Internal standards compatibility		
External standards compatibility		





Predictions

- Agent will be interruptible
- Partial ordering constraint on appraisal generation
- Different emotions may require different amounts of processing
- Time constraints may lead to errors in Comprehension (and thus emotion)



Summary: Unification of Cognitive Functions and Appraisal

- Structural appraisal theories define only the critical data used to drive behavior
- PEACTIDM defines critical functions, but not how they are achieved
- In general, appraisals are:
 - Generated by Perceive, Encode and Comprehend
 - The information needed by Attend, Comprehend, Tasking and Intend

Event Knowledge Hierarchy 2

