Situation Comprehension and Emotion

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Emotions: Appraisal theory

- Evaluate situation along several dimensions
  - Relate situation to current goals
  - Compare situation to expectations
  - Determine causality
  - Determine social acceptability
- Evaluations map onto emotions
  - Example: Highly relevant, predictable, goal-conducive situation → Joy

Evaluating from scratch is hard

- In general, how do we…
  - Relate the situation to current goals?
  - Make predictions?
  - Determine causality?
- In general, how does one understand what is going on?
  - "Soar interprets the environment by applying *comprehension operators* to specific aspects of an environment it wants to comprehend….What gets produced by executing a comprehension operator is a data structure in the current state that is the comprehension, by virtue of its being interpretable by other parts of Soar in doing other tasks."*

*Newell, UTC, 1990

Properties of a general comprehension theory

- Incremental
  - We perceive situations in pieces, so we need to work with those pieces
- Happens over time
  - Situations unfold as a series of ordered events
- Immediate comprehension*
  - Don’t waste time – fully utilize this moment
  - May want to respond now
  - Early commitment to an interpretation prevents combinatorial blowup of possibilities
- Ambiguity resolution
  - Commit to an interpretation even if not sure which is correct
  - Repair interpretation if new information indicates previous ambiguity was resolved incorrectly

*Just & Carpenter 1987

Previous work: NL-Soar*

- NL-Soar has these properties
  - Incremental: Process one word at a time
  - Happens over time: Words come in sequence
  - Immediate comprehension: Commits to a parse structure
  - Ambiguity resolution: “Snips” previous commitments when current parse fails
- NL-Soar is organized around models
  - Utterance model
  - Situation model
- NL-Soar is about understanding language – we want to understand situations

*Lewis 1993

Schema theory

- Schema = model
- A schema is knowledge about a concept
  - Data structure representing interpretation
  - Long-term knowledge about the relationships between the concept parts
    - Default values
    - Constraints
- Interpretation = instantiated schema
- Situation schemata are sequences of lower-level events which compose higher-level abstract events

Schema example: Structure

- Water balloon toss
  - Throw
    - Body language (happy/angry)
  - Travel
    - Trajectory (near/far)
    - Speed (slow/fast)
  - Catch
    - Success (true/false)
    - Causal agent (catcher/thrower)

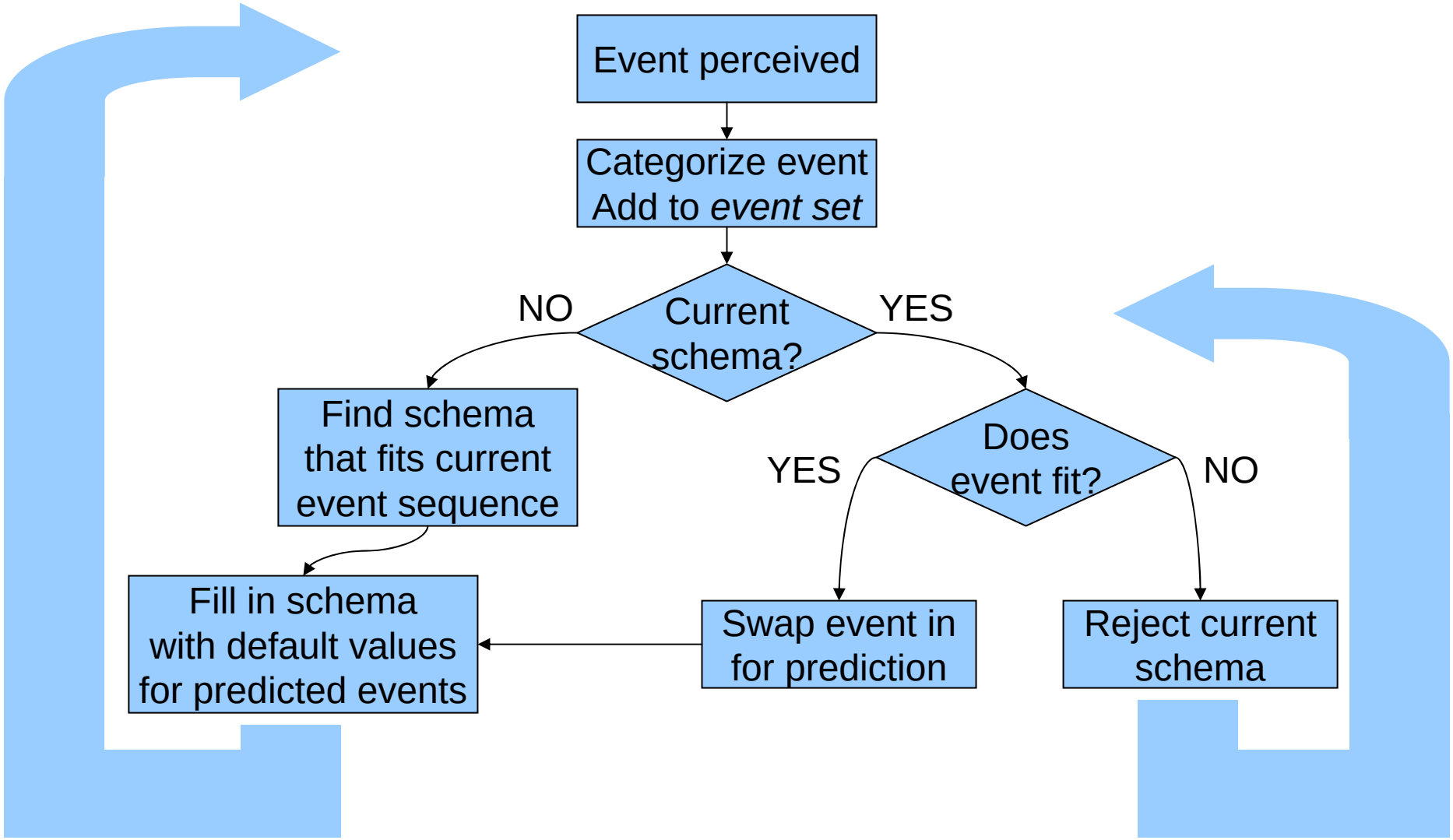
Schema example: Predictions

- Water balloon toss
  - Throw
    - Body language: (**happy**/angry)
  - Travel
    - Trajectory: (**near**/far)
    - Speed: (**slow**/fast)
  - Catch
    - Success: (**true**/false)
    - Causal agent: (thrower/catcher)
- If the thrower looks happy, then I expect the balloon's travel to be near and slow.
- If the balloon's travel is near and slow, then I expect the catch to succeed.

Schema example: Causality

- Water balloon toss
  - Throw
    - Body language: (happy/angry)
  - Travel
    - Trajectory: (**near**/far)
    - Speed: (**slow**/fast)
  - Catch
    - Success: (true/**false**)
    - Causal agent: (thrower/**catcher**)
- If the balloon's travel is near and slow and the catcher fails to catch it, then it's the catcher's fault.

Comprehension system



Comprehension system

- Incremental
  - Handle one event at a time
- Happens over time
  - Events occur in sequence
- Immediate comprehension
  - Early commitment to an interpretation
- Ambiguity resolution
  - Reinterprets if previous commitments fail

Comprehension example

- Event Set
  - Throw
    - Body language: happy

- Current interpretation: Water balloon toss
  - Throw
    - Body language: happy
  - *Travel*
    - *Trajectory: near*
    - *Speed: slow*
  - *Catch*
    - *Success: true*
    - *Causal agent: thrower*

Comprehension example

- Event Set
  - Throw
    - Body language: happy
  - Travel
    - Trajectory: near
    - Speed: slow
- Current interpretation: Water balloon toss
  - Throw
    - Body language: happy
  - *Travel*
    - *Trajectory: near*
    - *Speed: slow*
  - *Catch*
    - *Success: true*
    - *Causal agent: thrower*

Appraisals and interpretation

- Situation interpretation provides us with a framework for generating appraisals
  - Relate interpretation to goals
    - Example: Do I want the outcome I'm predicting?
  - Evaluate the comprehension process
    - Example: Are my predictions accurate?
  - Determine causality
    - Example: What does my schema knowledge say about who's at fault?

Appraisal example

- Event Set
  - Throw
    - Body language: happy

- Current interpretation: Water balloon toss
  - Throw
    - Body language: happy
  - *Travel*
    - *Trajectory: near*
    - *Speed: slow*
  - *Catch*
    - *Success: true*
    - *Causal agent: thrower*

Appraisal example

- Event Set
  - Throw
    - Body language: happy
  - Travel
    - Trajectory: far
    - Speed: fast

- Current interpretation: Water balloon toss
  - Throw
    - Body language: happy
  - *Travel*
    - *Trajectory: near*
    - *Speed: slow*
  - *Catch*
    - *Success: true*
    - *Causal agent: thrower*

Appraisal example

- Event Set
  - Throw
    - Body language: happy
  - Travel
    - Trajectory: far
    - Speed: fast
- Appraisals
  - Discrepancy from expectation

Update predictions

- Current interpretation: Water balloon toss
  - Throw
    - Body language: happy
  - Travel
    - Trajectory: far
    - Speed: fast
  - *Catch*
    - *Success: false*
    - *Causal agent: thrower*

Other appraisals

- Causality is stored in the schema
  - Get for free if understand what's happening
- Relating long-term goals to situation may require a goal representation beyond Soar's goal stack

Nuggets & Coal

- Nuggets
  - Situation comprehension provides a framework for building agent functions
    - Appraisal generation
    - Goal generation via coping and predictions
- Coal
  - Learning schemata requires generating appraisals from scratch
    - Event grammar?
  - Implementation in very early stages