Generating Appraisals with Sequence & Influence Networks

Bob Marinier, SoarTech

29th Soar Workshop

June 2009

Motives

- Appraisal theories define information that is useful to agents
- How is that information generated?
- Exploring network representations of sequence and causal knowledge
- This is mostly speculative; very little has been implemented

Background: Appraisal Theories of Emotion

- A situation is evaluated along a number of appraisal dimensions, many of which relate the situation to current goals
  - Novelty, goal relevance, goal conduciveness, expectedness, causal agency, etc.
- Result of appraisals influences emotion
- Emotion can then be coped with (via internal or external actions)
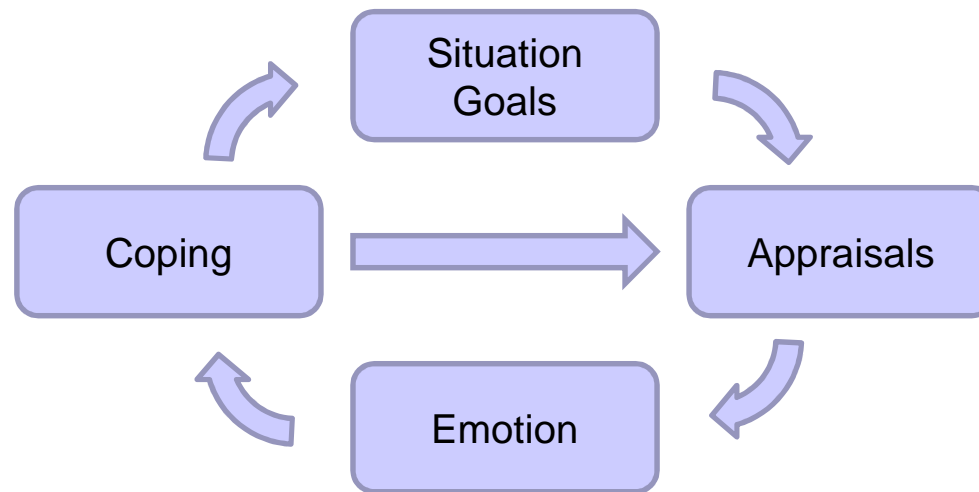
Appraisals to Emotions (Scherer 2001)

|	Joy	Fear	Anger
Suddenness	High/medium	High	High
Unpredictability	High	High	High
Intrinsic pleasantness		Low	
Goal/need relevance	High	High	High
Cause: agent		Other/nature	Other
Cause: motive	Chance/intentional		Intentional
Outcome probability	Very high	High	Very high
Discrepancy from expectation		High	High
Conduciveness	Very high	Low	Low
Control			High
Power		Very low	High

Semantic sequence networks

- Encode knowledge about common sequences
  - E.g., After breakfast, I always go to work
- Not episodic – not about specific sequences

Example: Thesis sequence network

- A sequence network consists of nodes corresponding to events, and directed links corresponding to time steps

Link strength

Event 2

0.1

Event 1

0.4
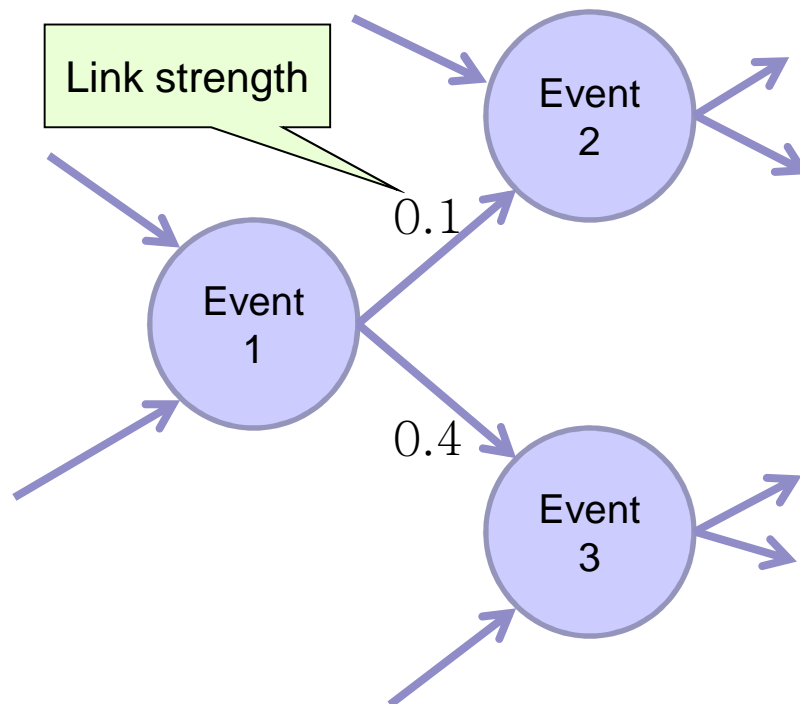
Event 3
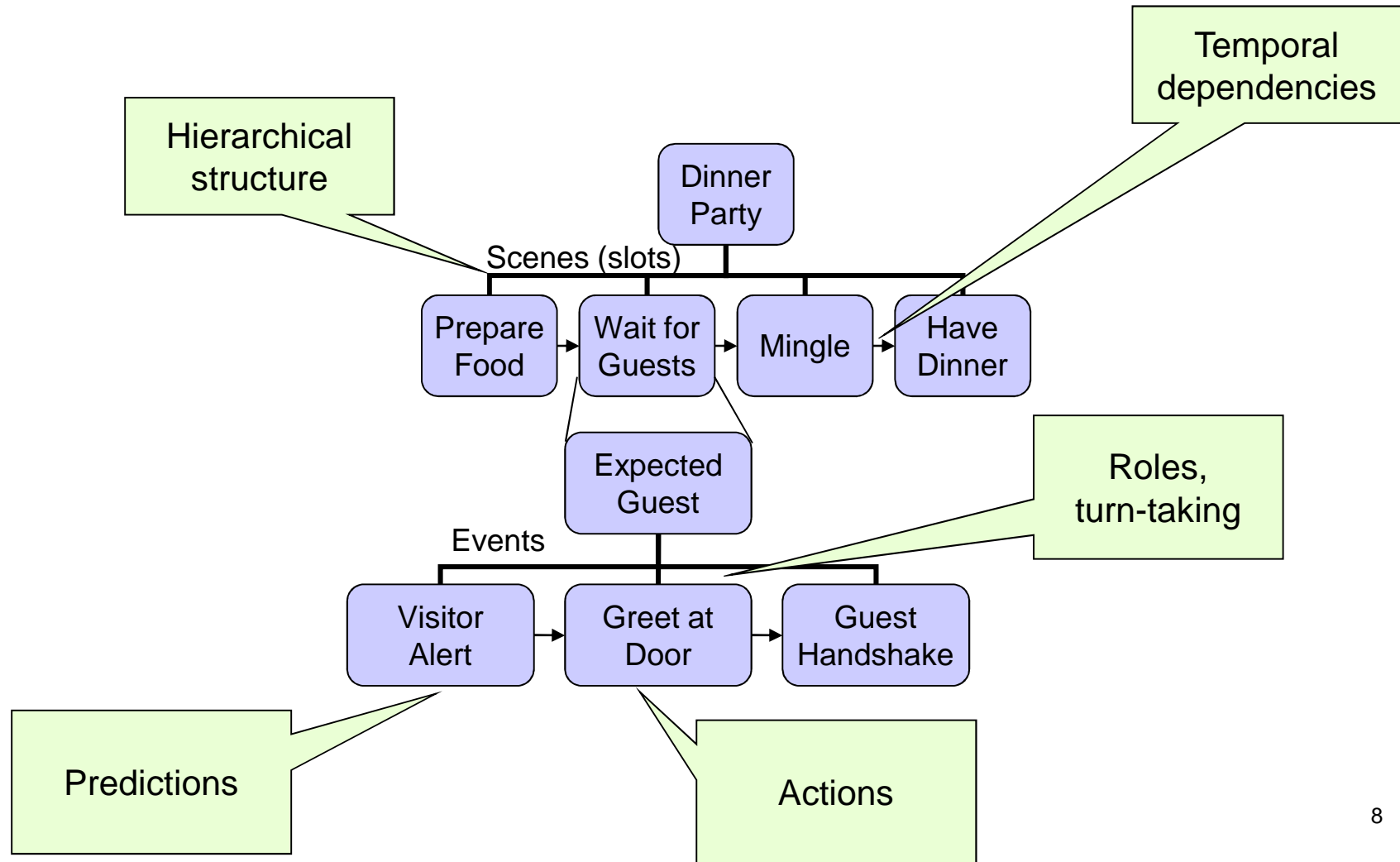
- Can create predictions (e.g., If see Event 1, will see Event 3 next)
- Can generate *outcome probability* appraisal (e.g., P(Event 3) = 0.4/(0.4+0.1) = 80%
- Can generate *discrepancy from expectation* by comparing outcome to prediction
- Other appraisals computed by separate rules not related to this network

Methods for generating appraisals

	Thesis work	Hierarchical sequence networks	Influence networks
Suddenness			
Familiarity			
Predictability			
Intrinsic pleasantness	Rules		
Goal relevance	Rules		
Causal agency			
Causal motive			
Outcome probability	Network link strength		
Discrepancy from expectation	Network node		
Goal conduciveness	Rules		
Urgency			
Control			
Power			
Adjustment			
Internal standards compatibility			
External standards compatibility			

Example:
Hierarchical semantic sequence networks

Temporal
dependencies

Hierarchical
structure

Dinner
Party

Scenes (slots)

Prepare
Food

Wait for
Guests

Mingle

Have
Dinner

Expected
Guest

Roles,
turn-taking

Events

Visitor
Alert

Greet at
Door

Guest
Handshake

Predictions

Actions

Generating appraisal values

Goal Relevance = Change(activation of goal)
Goal Conduciveness = +/-Change(activation of goal)

Predictability = Change(activation of previously active)

Outcome Probability
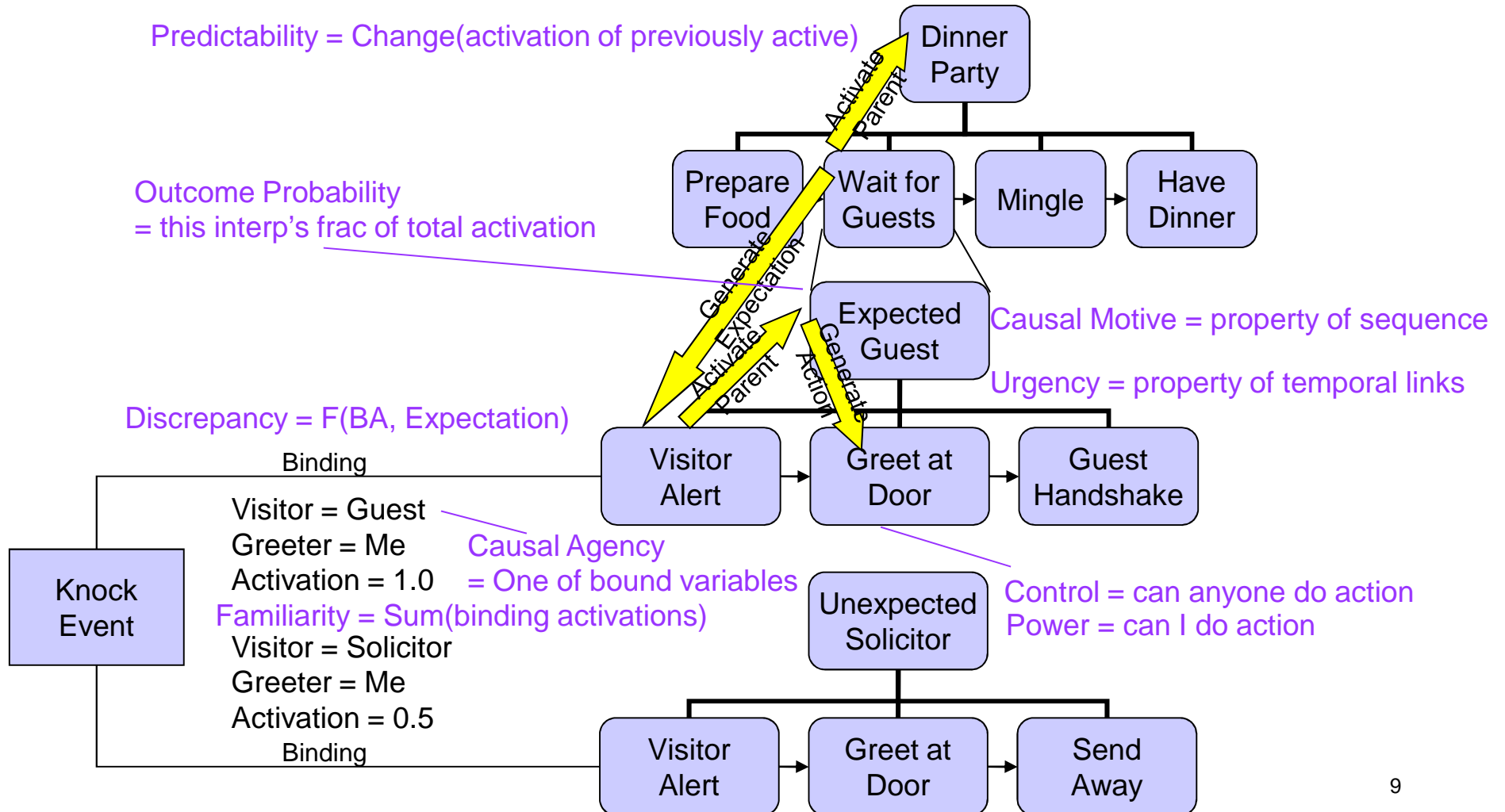= this interp's frac of total activation

Causal Motive = property of sequence

Urgency = property of temporal links

Discrepancy = F(BA, Expectation)

Binding

Visitor = Guest
Greeter = Me
Activation = 1.0

Causal Agency
= One of bound variables

Familiarity = Sum(binding activations)

Visitor = Solicitor
Greeter = Me
Activation = 0.5

Binding

Control = can anyone do action
Power = can I do action

Activate Parent

Generate Expectation

Activate Parent

Generate Action

Dinner Party

Prepare Food

Wait for Guests

Mingle

Have Dinner

Expected Guest

Visitor Alert

Greet at Door

Guest Handshake

Knock Event

Unexpected Solicitor

Visitor Alert

Greet at Door

Send Away

9

Methods for generating appraisals

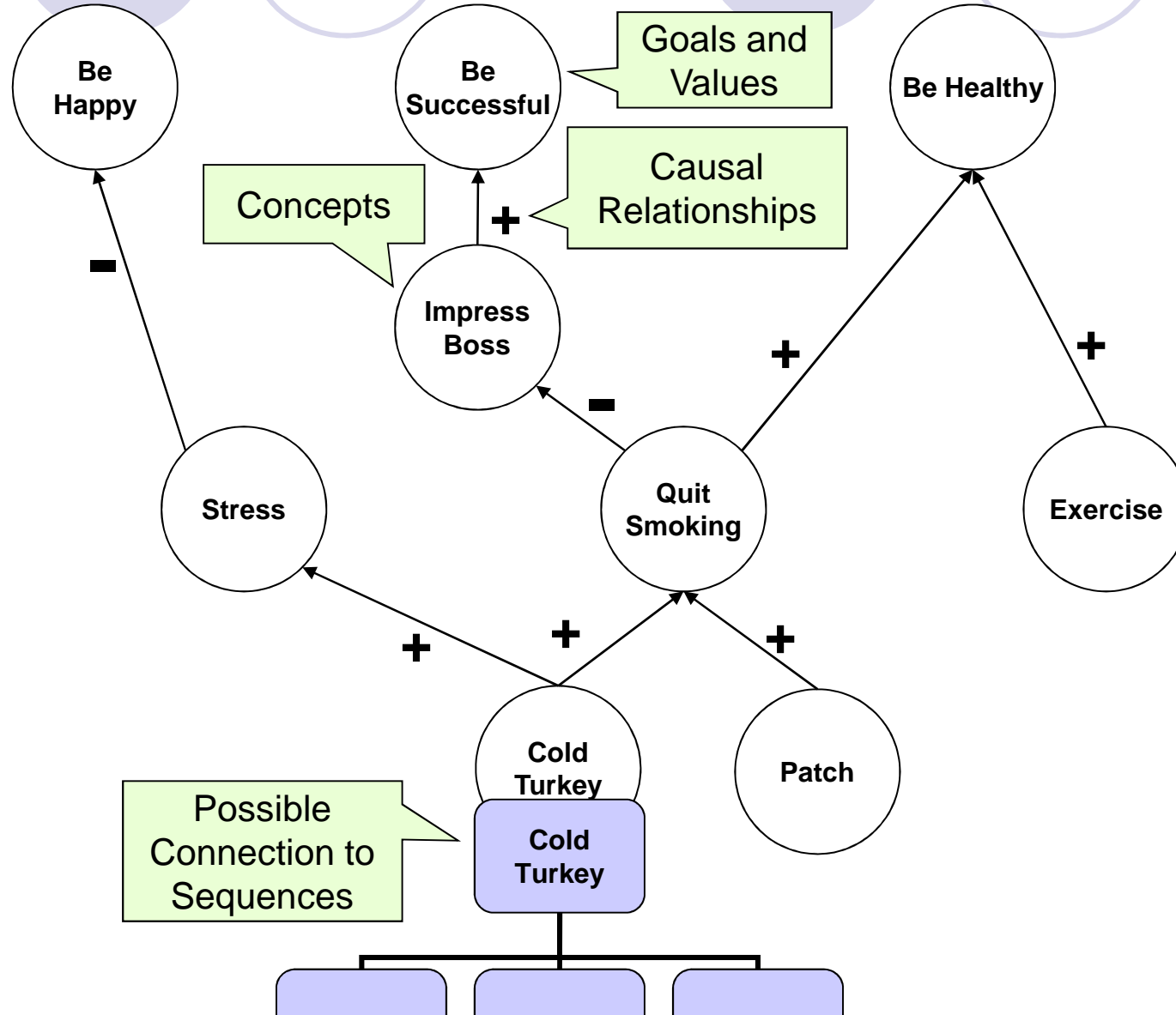|	Thesis work	Hierarchical sequence networks	Influence networks
Suddenness			
Familiarity		Activation change	
Predictability		Activation change	
Intrinsic pleasantness	Rules	Event/sequence metadata	
Goal relevance	Rules	Activation change	
Causal agency		Sequence binding	
Causal motive		Sequence metadata	
Outcome probability	Network link strength	Relative activation	
Discrepancy from expectation	Network node	Binding activation	
Goal conduciveness	Rules	Activation change	
Urgency		Sequence metadata	
Control		Rules? Bindings?	
Power		Rules? Bindings?	
Adjustment			
Internal standards compatibility			
External standards compatibility			

Influence networks

- Encode knowledge about causal relationships

  - Nodes are concepts, links are +/- causal relationships

- Like a specialized form of semantic memory

Example: Influence networks

Importance = 1   Importance = 1   Importance = 1
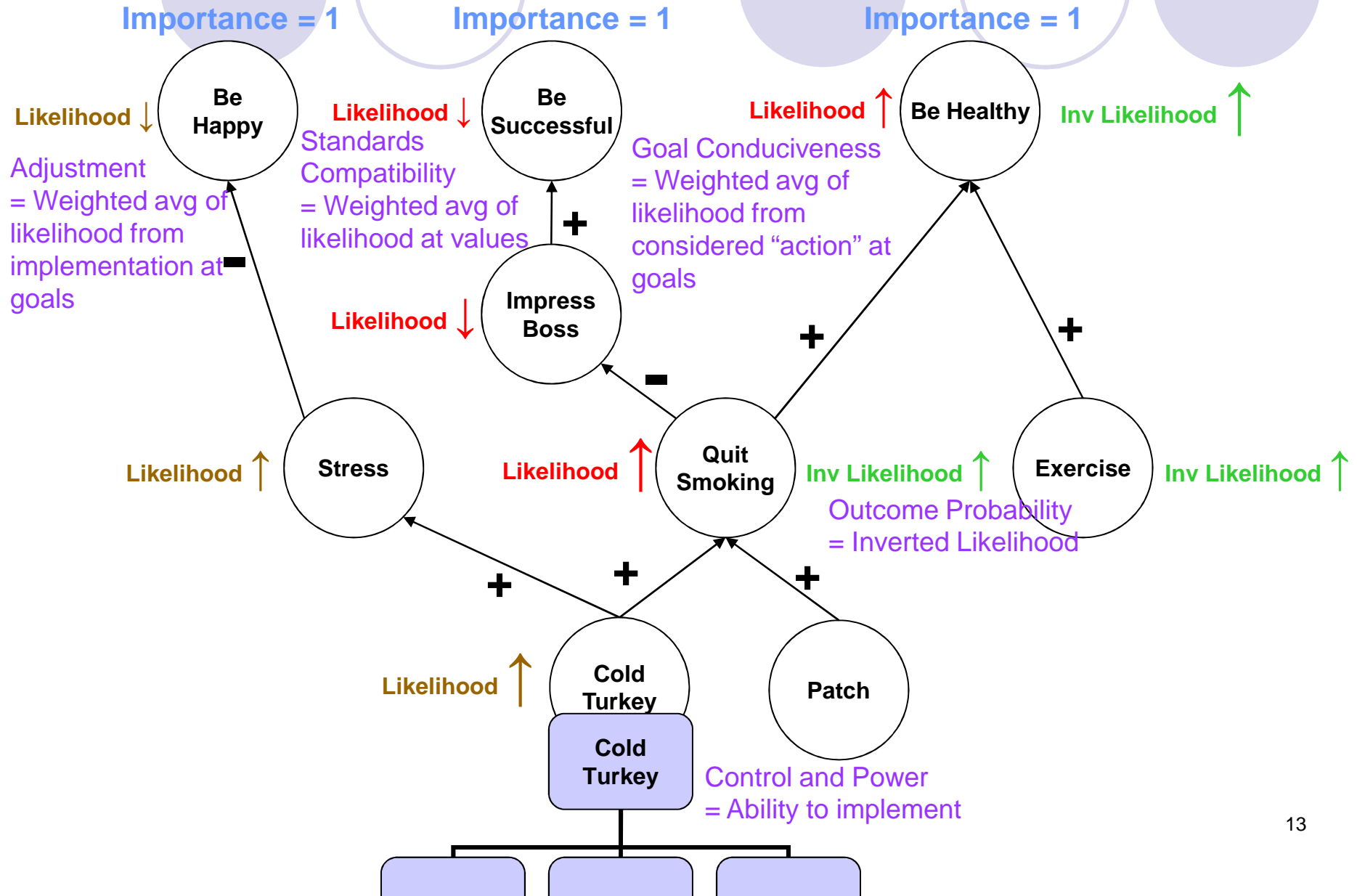
Be Happy

Be Successful — Goals and Values

Be Healthy

Causal Relationships

Concepts

Impress Boss +

Stress −

Quit Smoking +   −

Exercise +

Cold Turkey +   +   Patch +

Possible Connection to Sequences

Cold Turkey

12

Generating appraisal values

Importance = 1   **Importance = 1**   **Importance = 1**

Be Happy

Be Successful

Be Healthy

Likelihood ↓   Likelihood ↓   Likelihood ↑   Inv Likelihood ↑

Adjustment = Weighted avg of likelihood from implementation at goals

Standards Compatibility = Weighted avg of likelihood at values

Goal Conduciveness = Weighted avg of likelihood from considered "action" at goals

−   **+**

Impress Boss

Likelihood ↓

Stress   Likelihood ↑   **Quit Smoking**   Inv Likelihood ↑   **Exercise**

−

+   **+**

Likelihood ↑   Inv Likelihood ↑

Outcome Probability = Inverted Likelihood

+   **+**   **+**

Cold Turkey   **Patch**

Likelihood ↑

Cold Turkey

Control and Power = Ability to implement

Methods for generating appraisal values

	Thesis work	Hierarchical sequence networks	Influence networks
Suddenness			
Familiarity		Activation change	
Predictability		Activation change	
Intrinsic pleasantness	Rules	Event/sequence metadata	
Goal relevance	Rules	Activation change	
Causal agency		Sequence binding	
Causal motive		Sequence metadata	
Outcome probability	Network link strength	Relative activation	Inverted likelihood from goal to considered "actions"
Discrepancy from expectation	Network node	Binding activation	
Goal conduciveness	Rules	Activation change	Weighted avg likelihood from considered "action" at goals
Urgency		Sequence metadata	
Control		Rules? Bindings?	Bindings to sequences?
Power		Rules? Bindings?	Bindings to sequences?
Adjustment			Weighted avg likelihood from considered "implementation" at goals
Internal standards compatibility			Weighted avg likelihood at values
External standards compatibility			Weighted avg likelihood at values

Nuggets and Coal

- Have a story about where all of Scherer's appraisals might come from

- Have multiple stories for some appraisals

- Actually implemented conduciveness in causal networks

- Story is mostly hand-wavy

- Have multiple stories for some appraisals

- Involves integrating two kinds of networks

Suggests new or modified architectural mechanisms to support these kinds of networks?