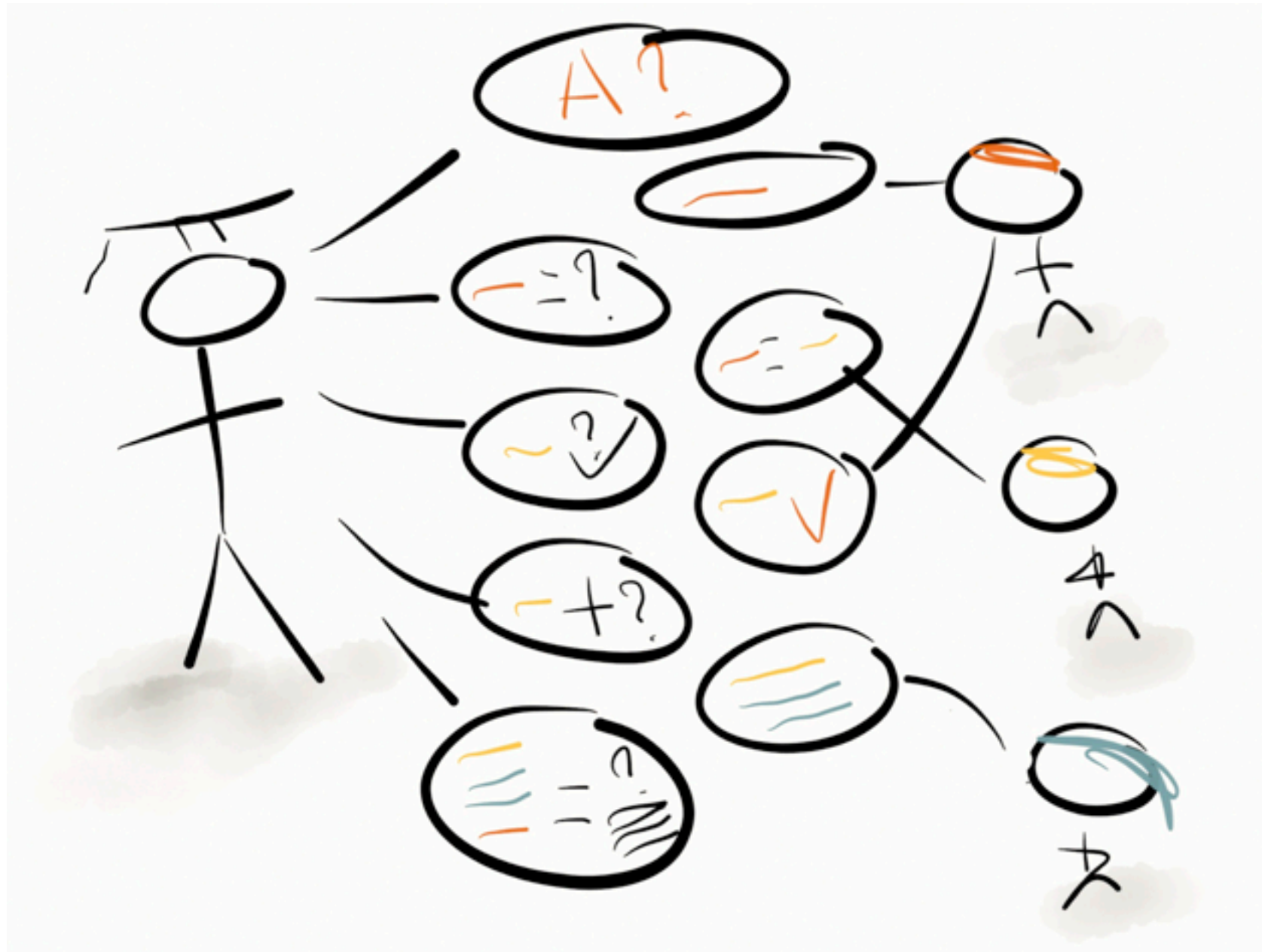# Bazaar:
Coordinating Multi-dimensional Support in Collaborative Conversational Agents

David Adamson and Carolyn Rosé
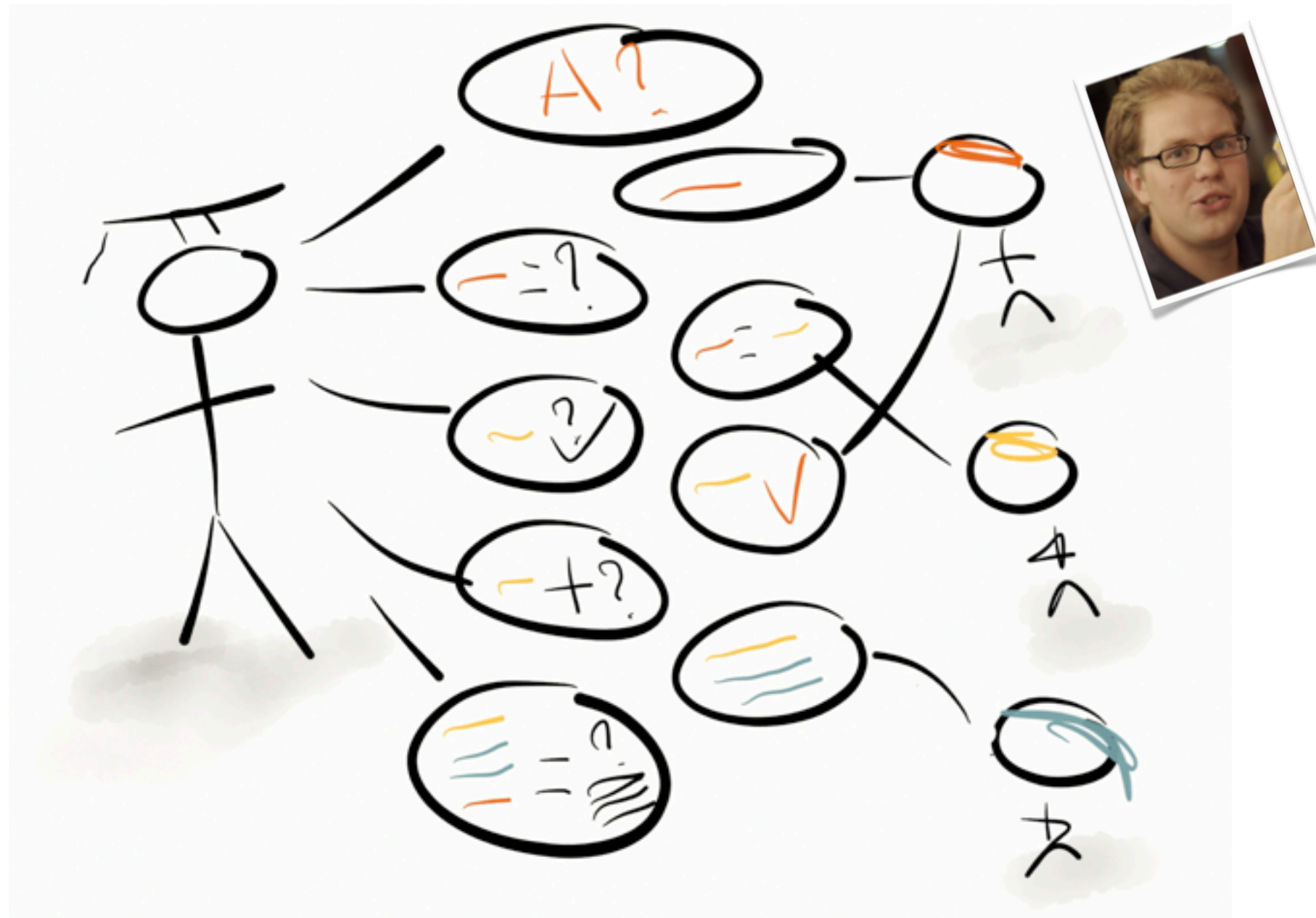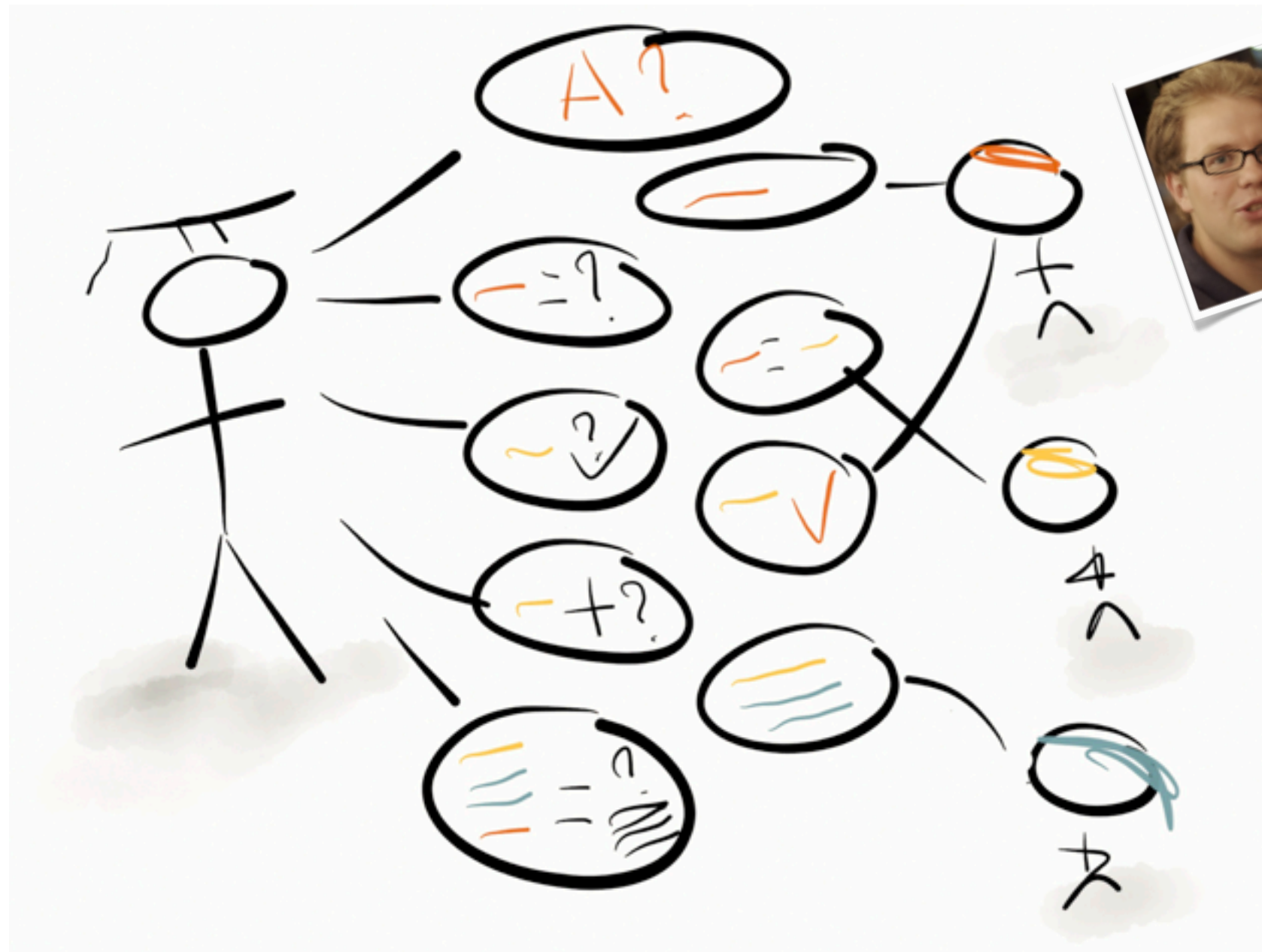Carnegie Mellon University

Collaborative Conversational Tutors

Collaborative Conversational Tutors

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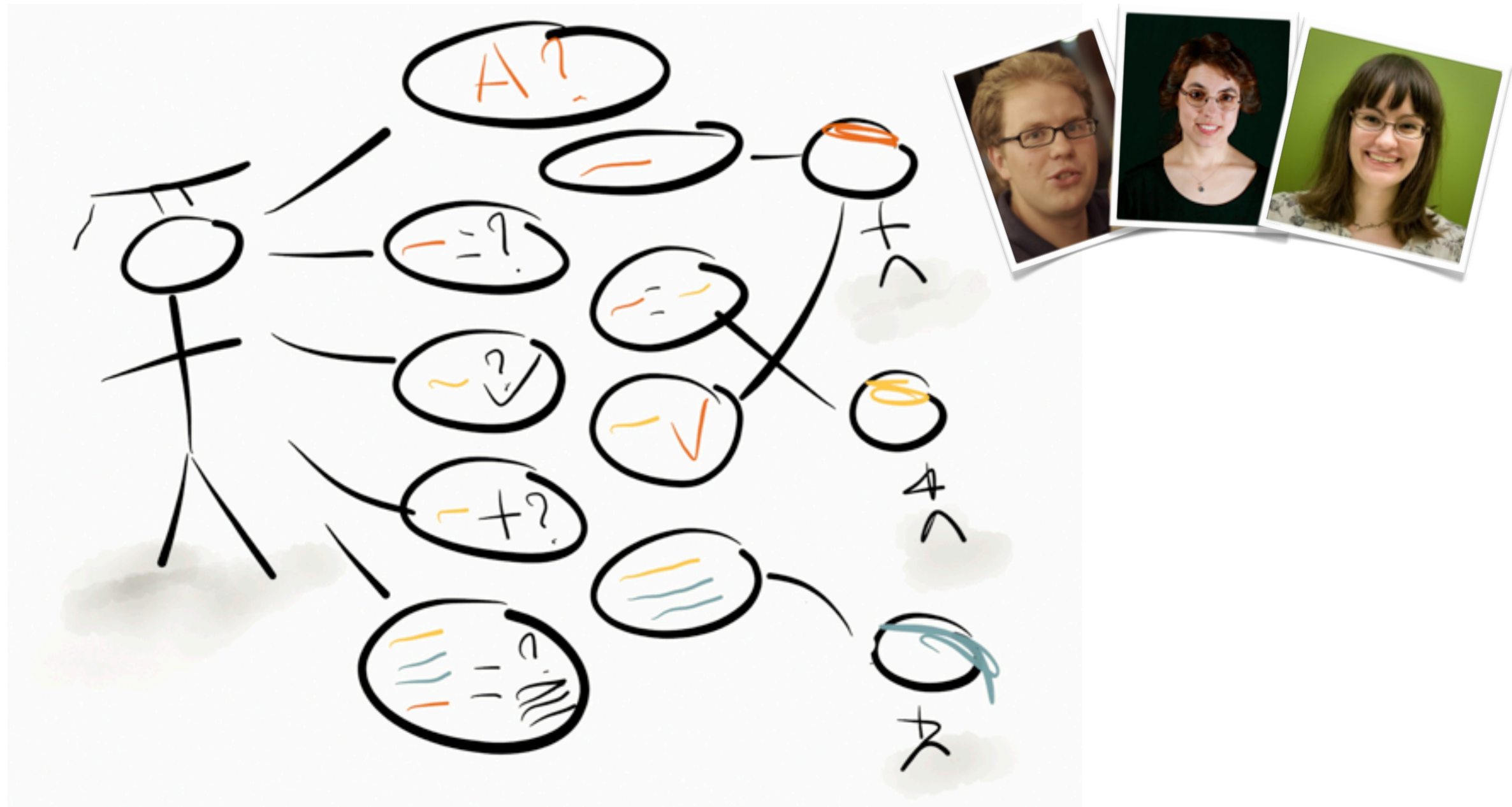
Collaborative Conversational Tutors
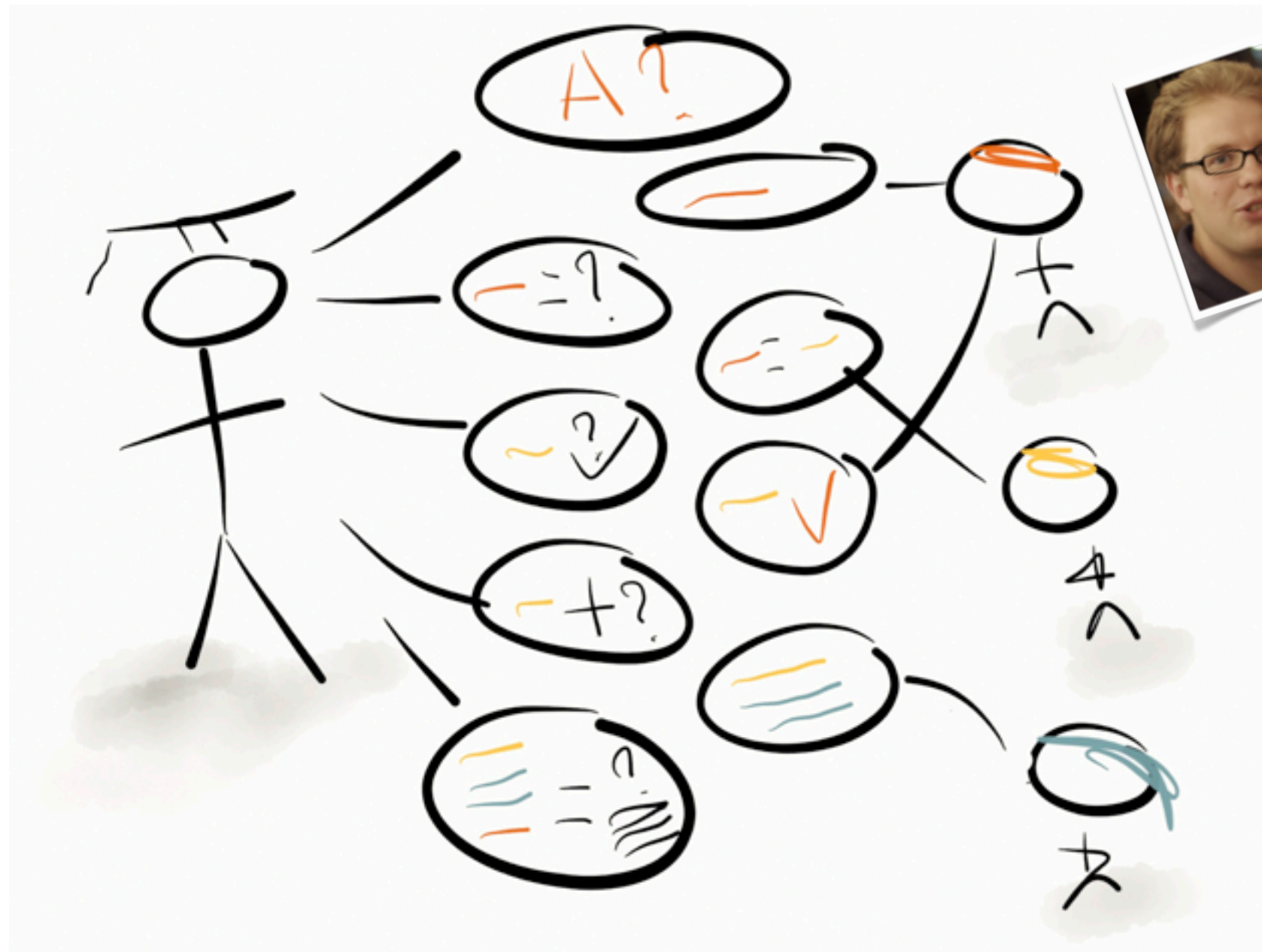
Collaborative Conversational Tutors
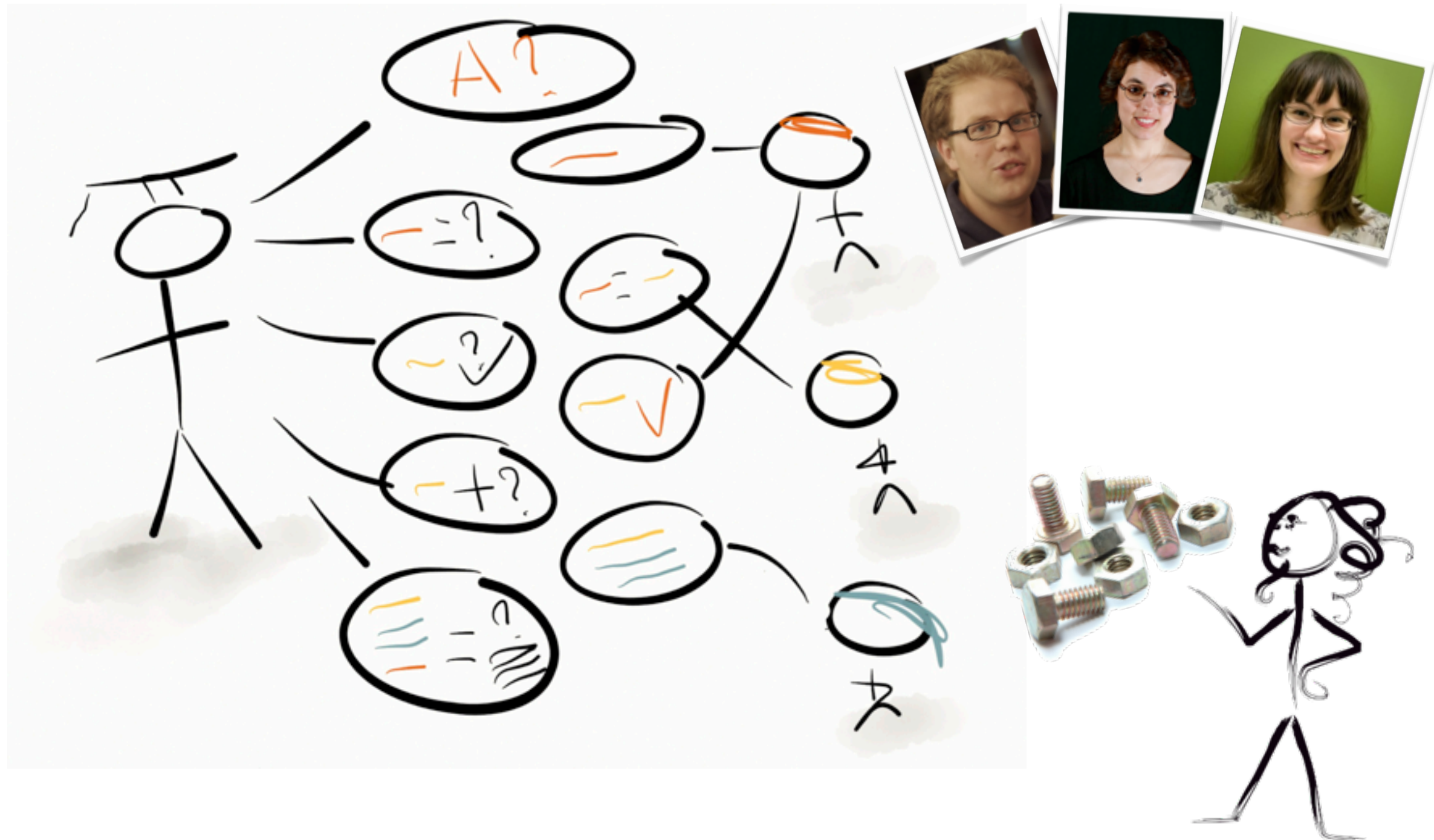
Multi-Dimensional Multiparty Dialog

Multi-Dimensional Multiparty Dialog

S02	12:57:35	noooo i think that the daddy is homozygous dominant and the mommy is heterozygous dominant. GG, Gg
S01	12:58:22	50% of the children are white so if one parent is gg and the other is Gg then this will create a 50% chance of having white babies
Tutor	12:58:27	So S01, what I hear you saying is recessive traits can be hidden in parents, but still show up in some of the children.

Multi-Dimensional Multiparty Dialog

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dynamic feedback

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dynamic feedback

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dynamic feedback

social awareness

Multi-Dimensional Multiparty Dialog

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S02	12:58:39	noooooooooo
Tutor	12:58:49	I wonder what S03 has to say.
S02	12:59:10	nothing she dont care
S03	12:59:33	shut up S02!!! i dont understand whats going on
S02	13:00:12	S03, its okay. just re look at the problem mamacitaaaaa :)
Tutor	13:00:22	Let's move on to the next problem...

dynamic feedback

social awareness

Multi-Dimensional Multiparty Dialog

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dynamic feedback

social awareness

static macro-script

Support for Collaborative Learning

- Support for collaborative learning can be described by **scripts** that scaffold and sequence the learners' interactions.

- A collaborative activity can be composed of multiple complementary scripts.

(Dillenbourg and Tchounikine, 2007)

Dimensions of Support

- **Macro**

  - sequence, timing, large structure of activity

- **Micro**
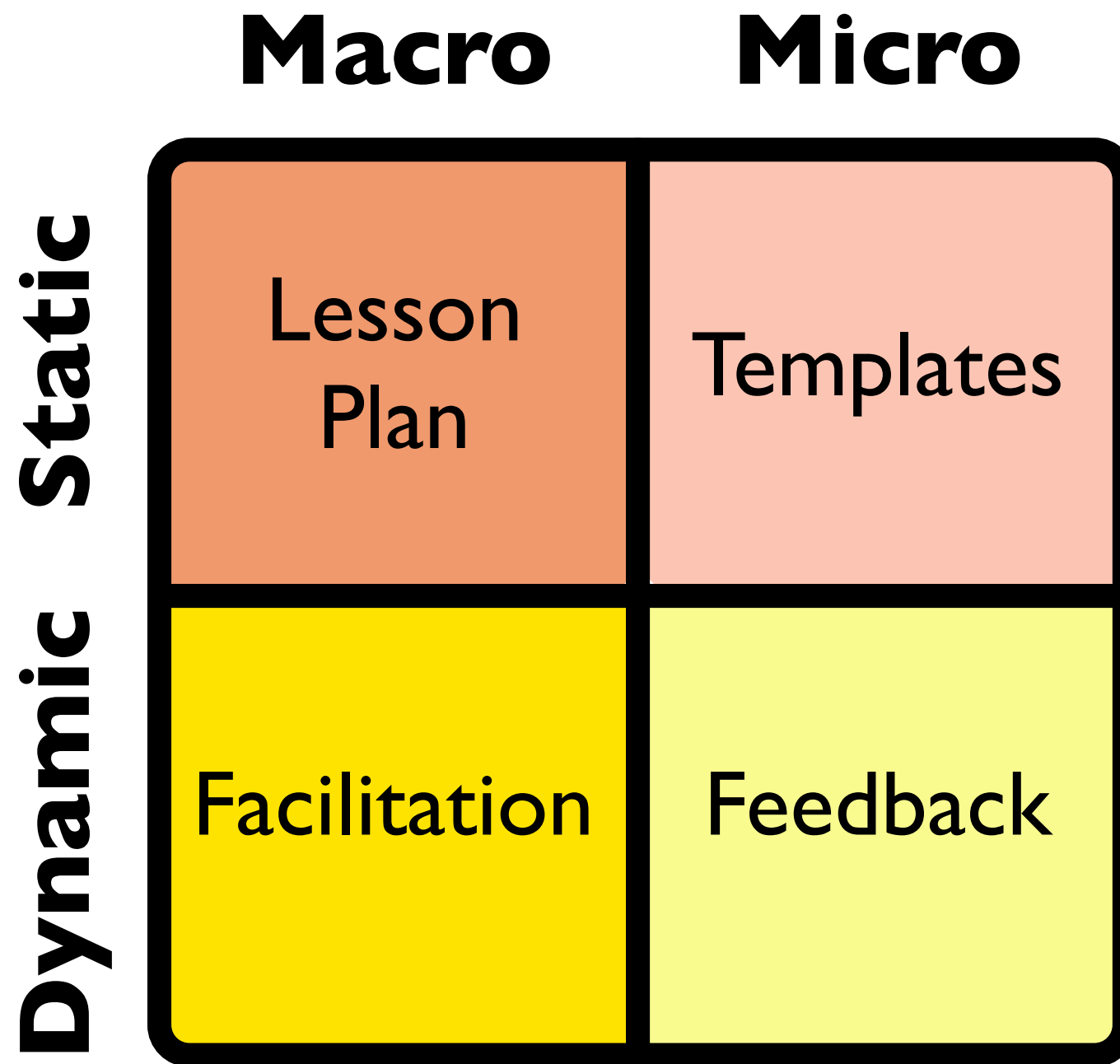
  - hints, feedback, support for student actions

Dimensions of Support

- **Static**
  - pre-defined sequences, sentence templates
- **Dynamic**
  - responsive to student behavior, context
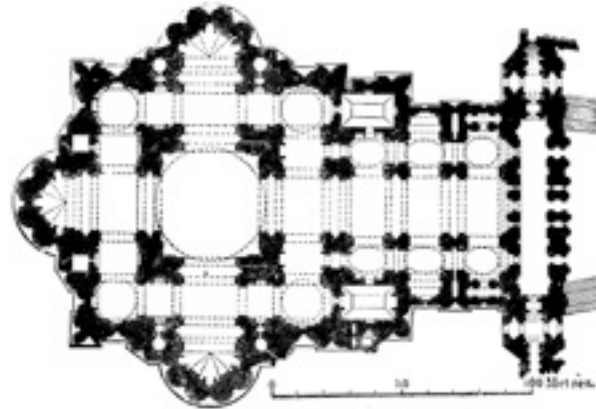
Dimensions of Support

Dimensions of Support

How to compose collaborative computer-supported activities with rich, multidimensional supports?

Basilica

- Modular event-based agent architecture

- Multiple collaborative conversational contexts

- Pioneer platform for dynamic scripting support
  Kumar et al, 2007, 2010

Behavior Coordination

Behavior Coordination

S01	12:58:35	yeah
S02	12:58:39	noooooooooo
Tutor	12:58:49	I wonder what S03 has to say.
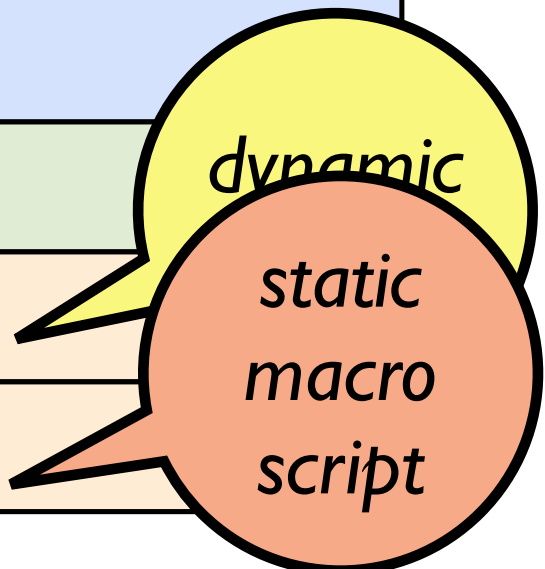
Behavior Coordination

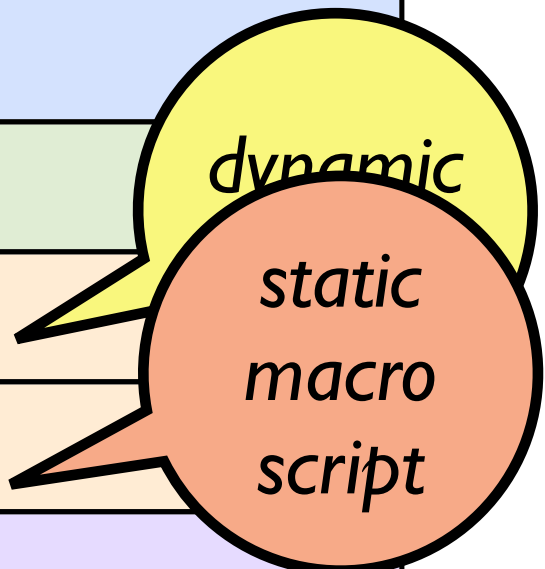| S01	12:58:35	yeah
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dynamic feedback

Behavior Coordination

S01	12:58:35	yeah
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Tutor	12:59:00	Let's move on to the next problem...

dynamic

static macro script

Behavior Coordination

S01	12:58:35	yeah
S02	12:58:39	nooooooooooo
Tutor	12:58:49	I wonder what S03 has to say.
Tutor	12:59:00	Let's move on to the next problem...
S03	12:59:04	...

dynamic

static macro script

Bazaar

- Based on Basilica

- Simplified event flow

- Built-in coordination between behaviors

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Pre-process
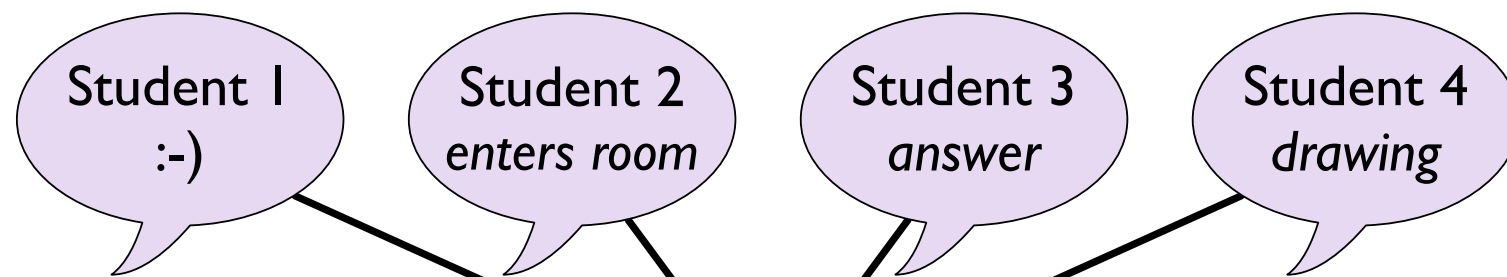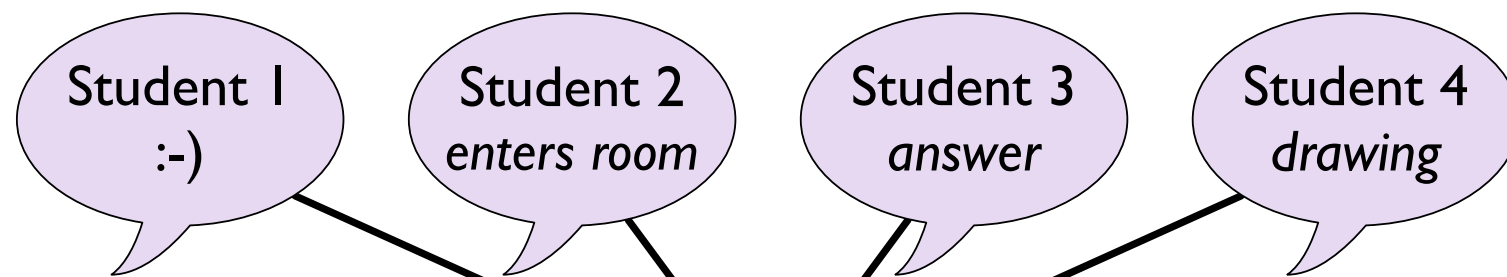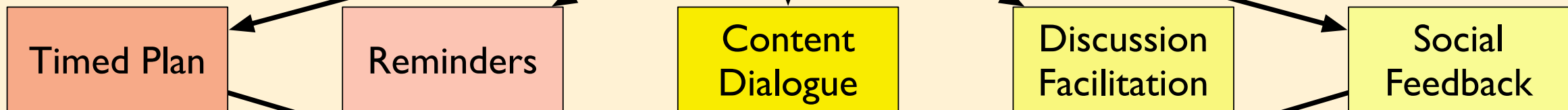
Propose
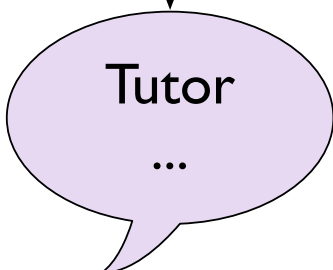
Output Coordinator
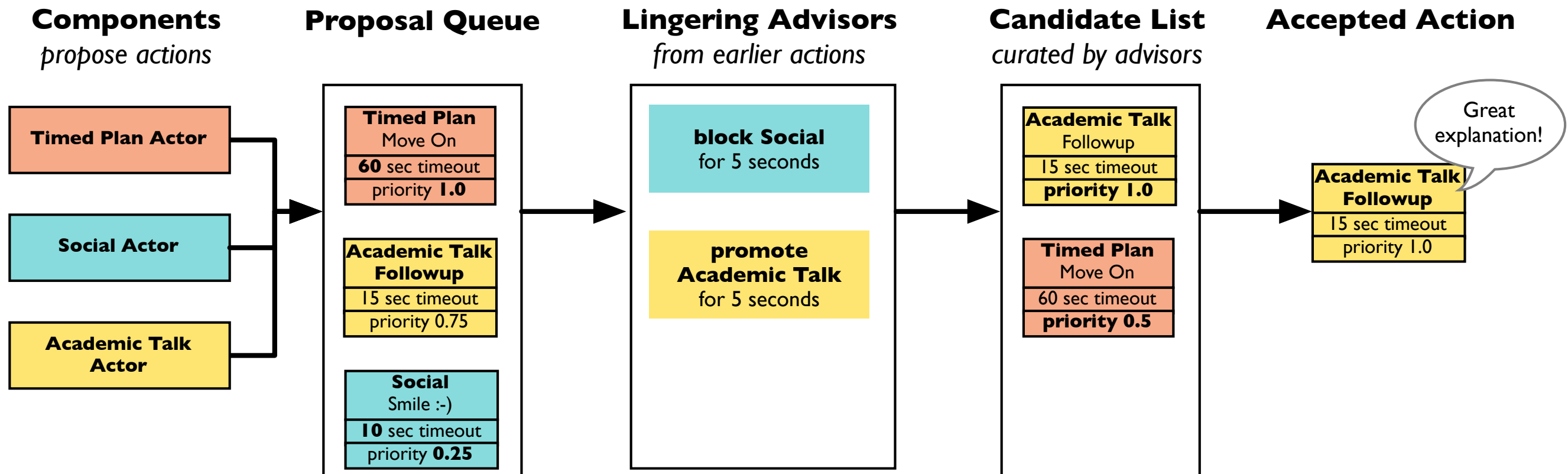
- Actions are proposed with a timeout (window of relevance) and a priority value

- Advisors (left by earlier accepted actions) influence the selection of incoming proposals to:

    - reserve the floor for followups

    - prefer proposals from certain sources

Output Coordinator

Components
propose actions

Proposal Queue

Lingering Advisors
from earlier actions

Candidate List
curated by advisors

Accepted Action

Timed Plan Actor

Social Actor

Academic Talk Actor

Timed Plan
Move On
60 sec timeout
priority **1.0**

Academic Talk Followup
15 sec timeout
priority 0.75

Social
Smile :-)
10 sec timeout
priority **0.25**

block Social
for 5 seconds

promote Academic Talk
for 5 seconds

Academic Talk
Followup
15 sec timeout
priority 1.0

Timed Plan
Move On
60 sec timeout
priority 0.5

Academic Talk Followup
15 sec timeout
priority 1.0

Great explanation!

Output Coordinator

Components

Proposal Queue
accepted proposal removed

Lingering Advisors
accepted action adds advisor

Candidate List

Accepted Action
notifies component of acceptance

Timed Plan Actor

Social Actor

Academic Talk Actor ✓

Timed Plan
Move On
60 sec timeout
priority **1.0**

Social
Smile :-)
10 sec timeout
priority **0.25**

block Social
for 5 seconds

promote Academic Talk
for 5 seconds

block Academic Talk
for 30 seconds

Academic Talk Followup
15 sec timeout
priority 1.0

Output Coordinator

Components	Proposal Queue	Lingering Advisors	Candidate List	Accepted Action
	accepted proposal removed	*accepted action adds advisor*		*notifies component of acceptance*

Timed Plan Actor

Social Actor

Academic Talk Actor

✓

Timed Plan
Move On
60 sec timeout
priority **1.0**

Social
Smile :-)
10 sec timeout
priority **0.25**

block Social
for 5 seconds

promote
Academic Talk
for 5 seconds

block
Academic Talk
for 30 seconds

Academic Talk Followup
15 sec timeout
priority 1.0

- Accepted proposals leave advisors that linger for a time after the proposal is enacted.

- When a proposal is accepted or rejected, it sends a callback to notify the originating component.

●●●●○○

Experimental Tradeoffs

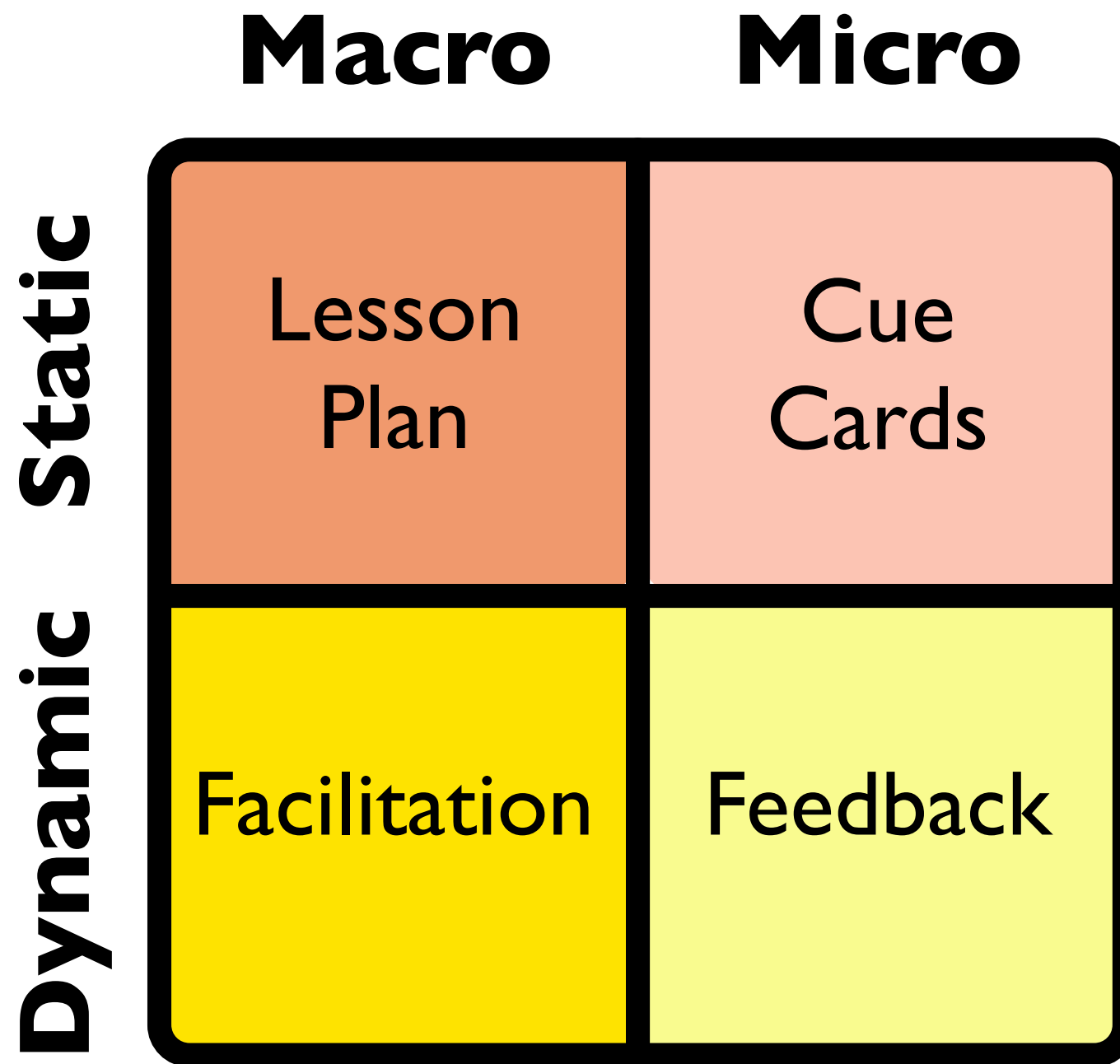|	+	-
Rigid Timing	Repeatable, Predictable, Internal validity	Behavior juxtapositions, Missed opportunities
Soft Timing	Flexible, Natural exchanges, External validity	Adds error variance, Less control of time

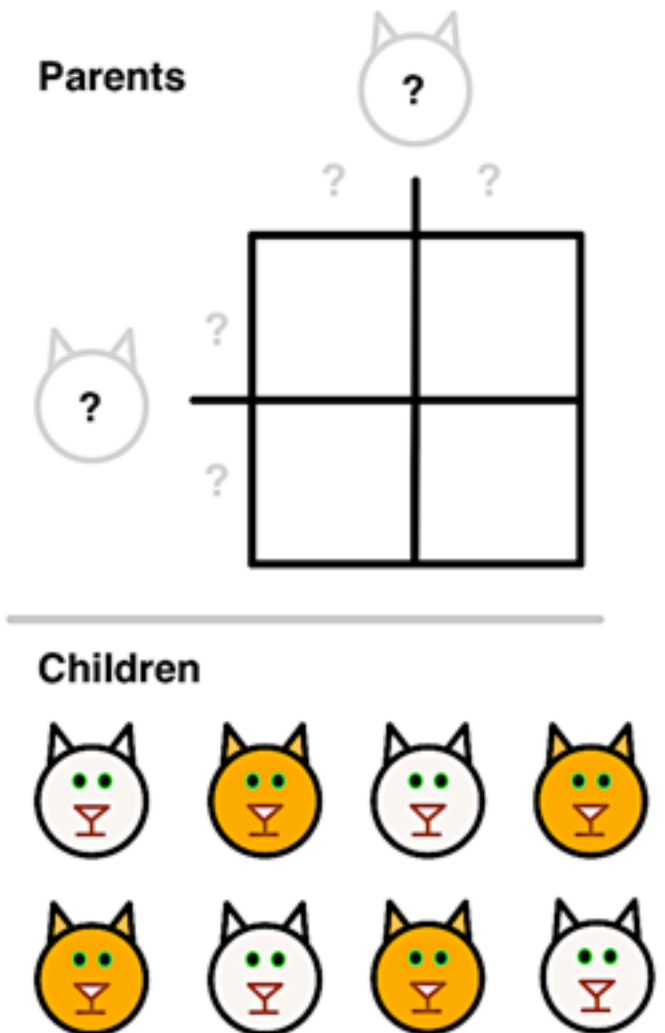# Tales of the Bazaar

Research Platforms for CSCL

••••

Dimensions of Support

Revoicing and APT

- Can tutor-led Academically Productive Talk (APT) increase student learning?

- 9th grade Biology, groups of 3 students

- Tutor offers "Revoice" and "Say More" APT moves in response to student contributions:

Parents

Children

S01	50% of the children are white so if one parent is gg and the other is Gg then this will create a 50% chance of having white babies
Tutor	**So S01, what I hear you saying is recessive traits can be hidden in parents, but still show up in some of the children.**

Revoicing and APT

	Macro	Micro
Static		
Dynamic		

Revoicing and APT

- Static, macro-scripted (rigidly timed) problem sequence

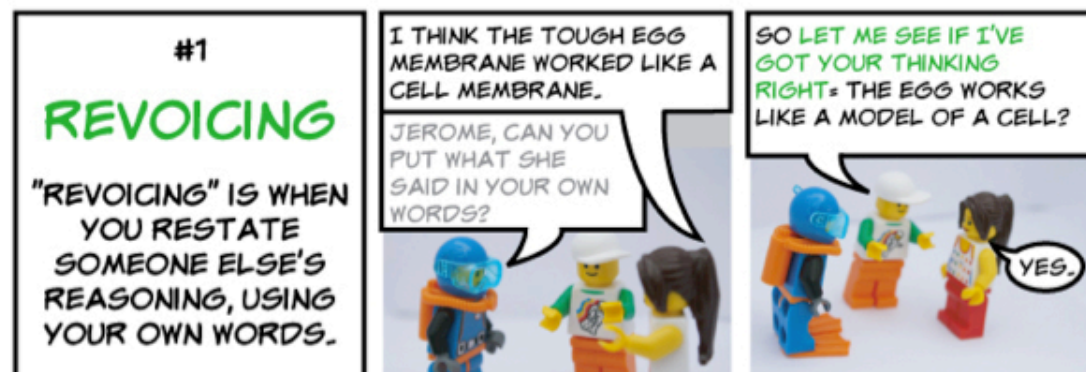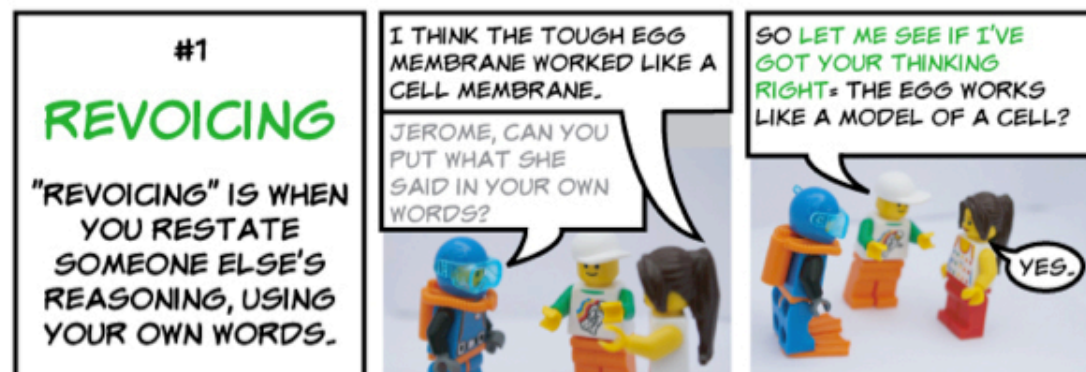|	**Macro**	**Micro**
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Revoicing and APT

- Static, macro-scripted (rigidly timed) problem sequence

- Static APT micro-reminders

Revoicing and APT

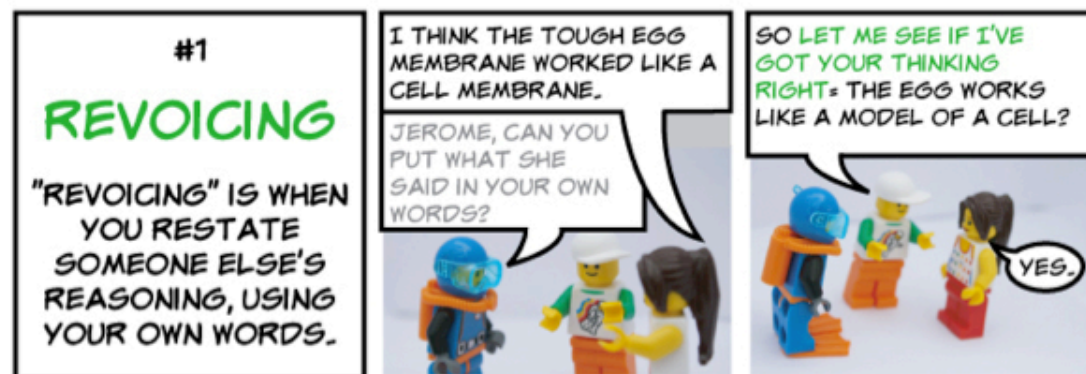- Static, macro-scripted (rigidly timed) problem sequence

- Static APT micro-reminders

- Dynamic social prompts (Kumar et al, 2010)

Revoicing and APT

- Static, macro-scripted (rigidly timed) problem sequence

- Static APT micro-reminders

- Dynamic social prompts (Kumar et al, 2010)

- Dynamic revoicings (APT) of student explanations: Bazaar reserves floor-space for student responses, promotes tutor followup moves

Targeting Student Self-Efficacy

Howley, Adamson, Dyke, Rosé, 2012

	Macro	Micro
Static		
Dynamic		

Targeting Student Self-Efficacy

Howley, Adamson, Dyke, Rosé, 2012

- How do targeted prompts affect the self-efficacy of student participants?

	Macro	Micro
Static		
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- Social moves from "clueless student" tutor, plus targeted questions to high/low efficacy students

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Targeting Student Self-Efficacy

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- How do targeted prompts affect the self-efficacy of student participants?

- Knowledge construction dialogues delivered by "professor" tutor

- Social moves from "clueless student" tutor, plus targeted questions to high/low efficacy students

- In a time-constrained setting, overly-soft timing can mean all of the dialogues don't get started.
  - choice of priorities and timeouts is important!

Facilitating Debate

Facilitating Debate

	Macro	**Micro**
Static		
Dynamic		

•••••

Facilitating Debate

- Can a balanced debate engender multi-perspective knowledge?

	Macro	Micro
Static		
Dynamic		
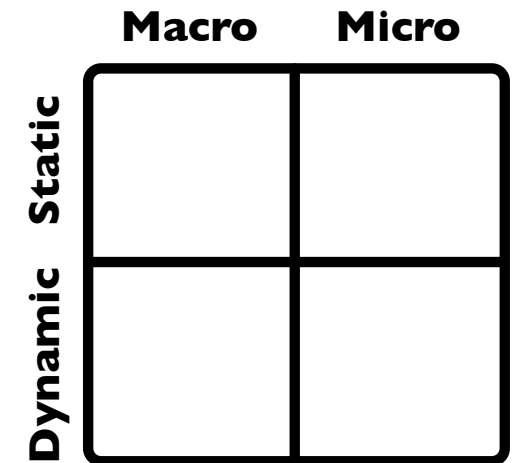
Facilitating Debate

- Can a balanced debate engender multi-perspective knowledge?

- Discussant participation is dynamically encouraged

	Macro	Micro
Static		
Dynamic		

Facilitating Debate

- Can a balanced debate engender multi-perspective knowledge?

- Discussant participation is dynamically encouraged

- Dynamically detect the current topic and the dominating "side" of the debate.
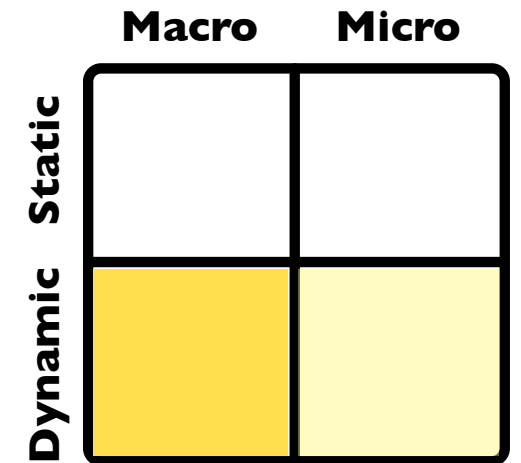
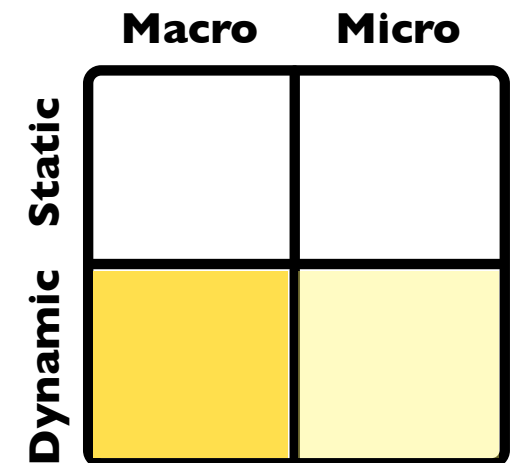**Macro** **Micro**

Static

Dynamic

Facilitating Debate

- Can a balanced debate engender multi-perspective knowledge?

- Discussant participation is dynamically encouraged

- Dynamically detect the current topic and the dominating "side" of the debate.

- Facilitator/Tutor dynamically directs the conversation by introducing facts and talking points for the weaker side

Discussion

- Bazaar is a reusable, freely-available platform for CSCL research

- Bazaar allows for flexibility in trading off between internal and external validity

- Support along multiple dimensions can be coordinated gracefully
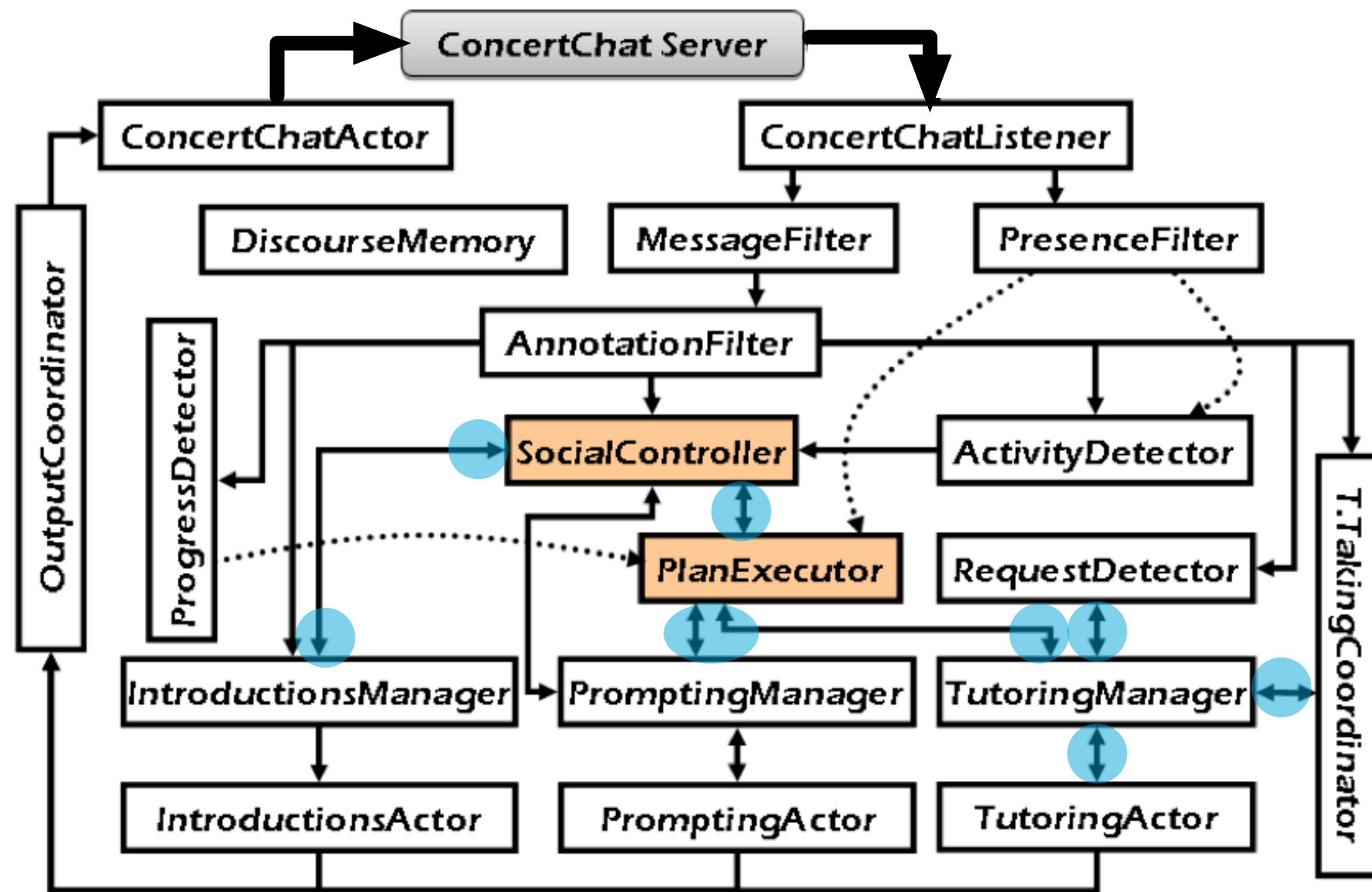
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Thanks!

Saturday, June 23, 12

Multi-Dimensional Multiparty Dialog

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S03	12:59:33	shut up S02!!! i dont understand... ...on
S02	13:00:12	S03, its okay. just re look at t... ...citaaaaa
Tutor	13:00:22	All right, we're wrapping up. Than...

revoicing proposed, permitted

participation prompt proposed, but blocked

participation prompt permitted

soical support proposed, but blocked

timed prompt proposed, permitted (high priority)
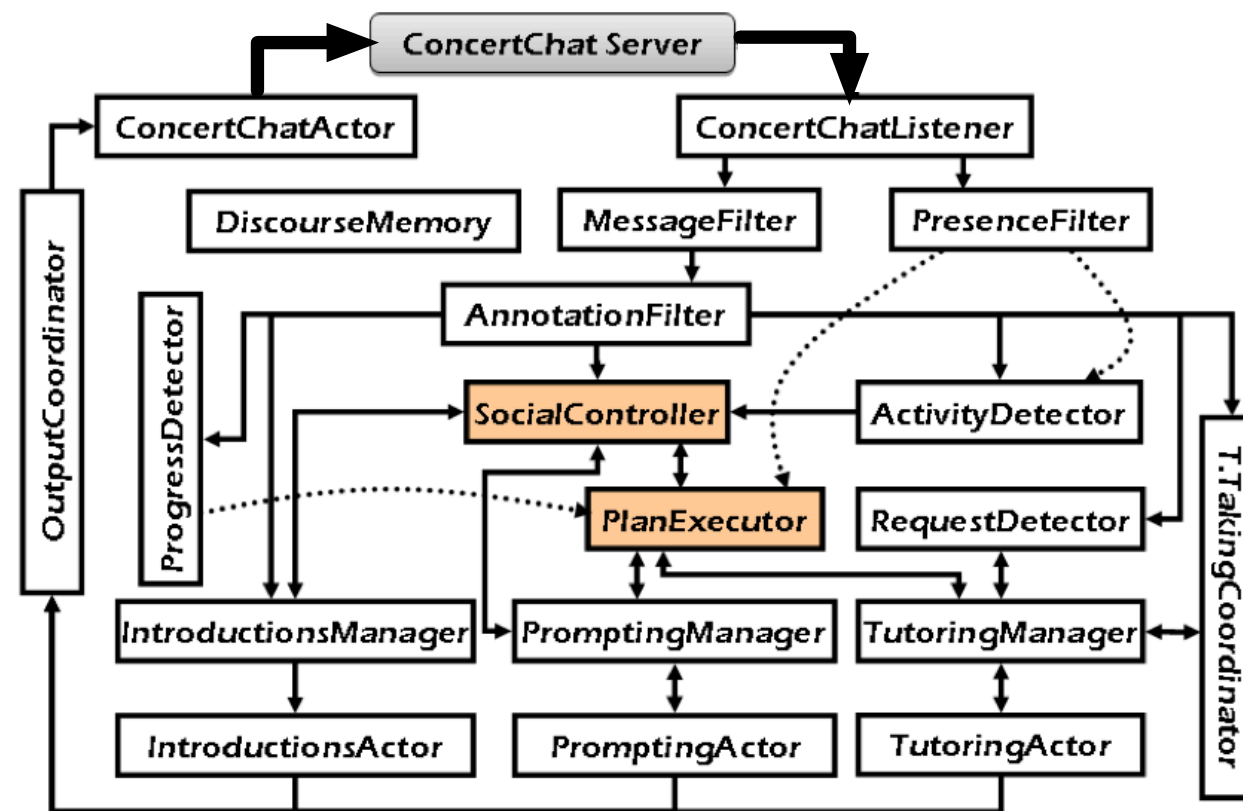
social support times out, rejected

Basilica Event Flow

most of the two-way links
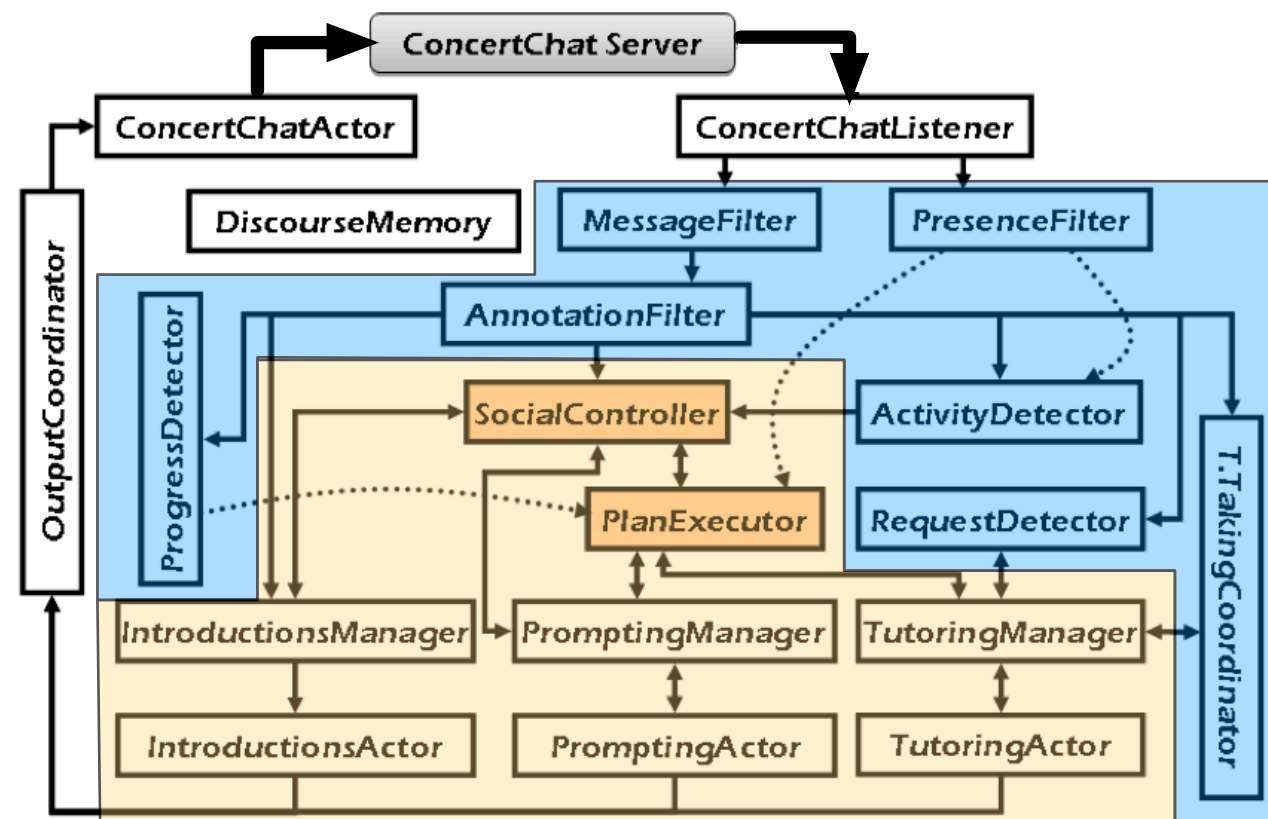manage behavior coordination...
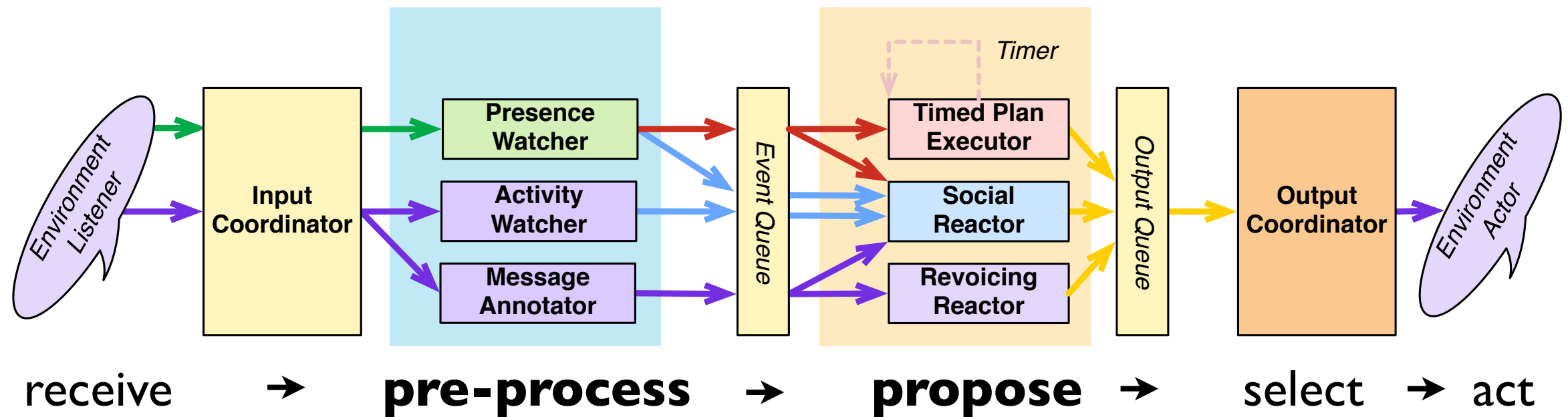
Basilica, but...

- Make implicit filter-actor pattern explicit

- Move inter-actor coordination out of each component, and into the framework

Basilica, but...

- Make implicit filter-actor pattern explicit

- Move inter-actor coordination out of each component, and into the framework
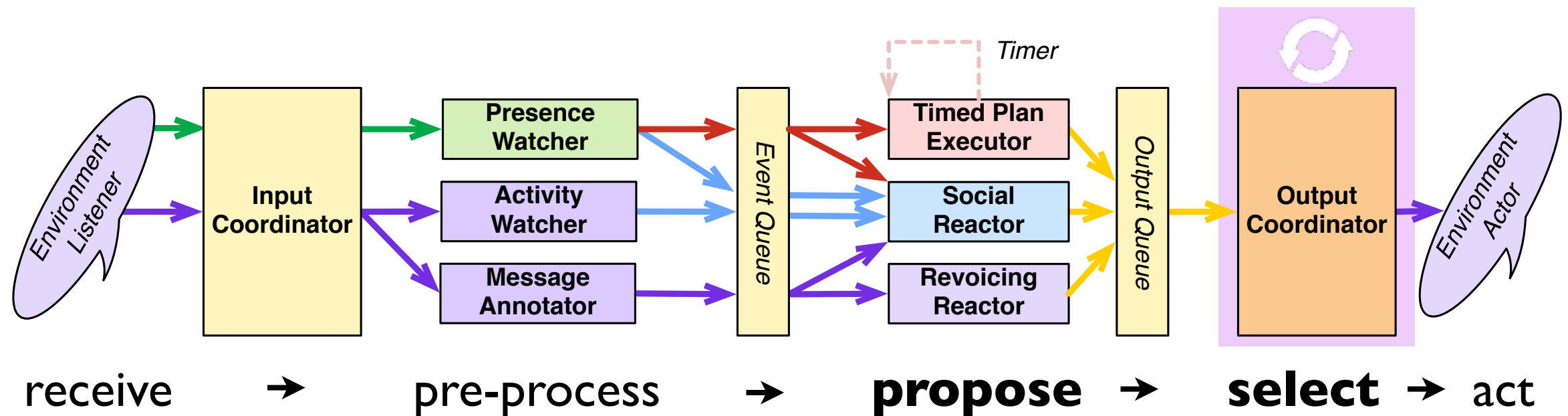
Bazaar Event Flow

receive → pre-process → propose → select → act

- components register for classes of events in either of two phases:

- **pre-process:** analyze incoming events, annotate them, or create new ones

- **propose:** react to preprocessed events, implement scripted support behaviors

Behavior Coordination

receive ➔ pre-process ➔ **propose** ➔ **select** ➔ act

- **Proposals** for action are defined with a priority weight, and a "lifespan" of relevance

- The highest-priority proposal is **selected** to be enacted in the shared environment

- Remaining proposals are queued until they're enacted, or are no longer relevant

Behavior Coordination

Action Proposal

Priority: 0.85	On Accept: {revoiceCount++}
Reject Timeout: 5 sec	On Reject: {}
Proposal Source	
Proposed Event: *"so are you saying that the membrane is selectively permeable?"*	

Proposal Source

Source Name: "Revoice"
Source Timeout: 10 sec
Block Sources: ALL
Exceptions: "Followup", …

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- **Proposal Sources** linger after their proposal is enacted

- Influence the selection of future proposals:

  - reserve the floor for followups

  - prefer proposals from certain sources

(Lison, 2011)