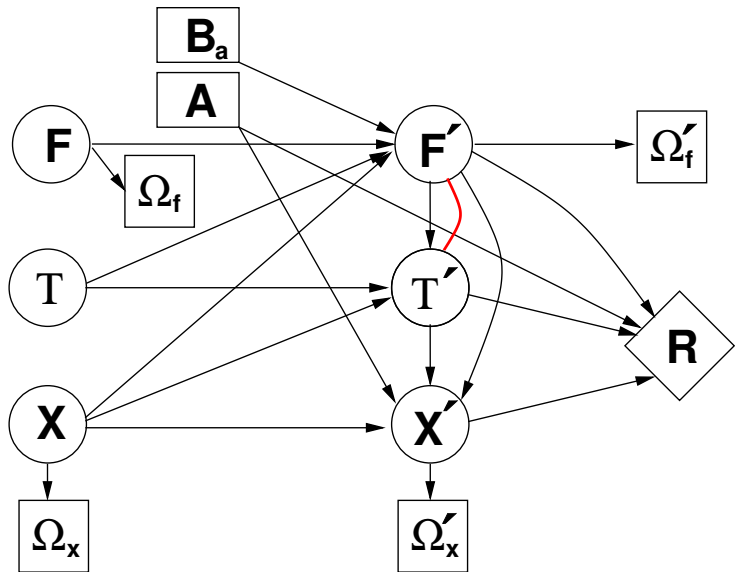


Bayesact III - Applications and Results

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Feb 4th, 2014

Reminder - BayesAct



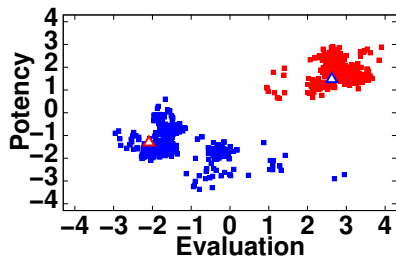
Testing

1. Analytical reduction of *BayesAct* to ACT
2. Run *BayesAct* (fixed ids) alongside *Interact*
3. Simulate with unknown identities
4. Simulate adaptation to changing identities
5. proof of concept system (tutoring, handwashing)

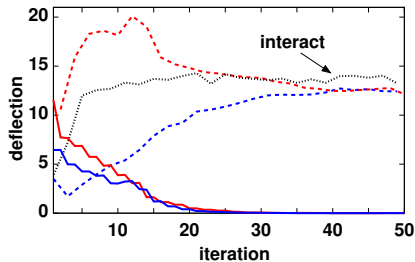
Key Parameters

param.	default	meaning
α	1.0	variance of a diagonal uniform Σ , the deflection potential covariance. (smaller means the affect control principle is stronger)
β_a	0.01	identity inertia for agent (larger means agent shifts identities more)
β_c	0.01	identity inertia for client (larger means agent thinks client will be shifting identities more)
β_a^0	0.01	initial identity variance for agent (larger means agent is more uncertain of its own identity)
β_c^0	0.01	initial identity variance for client (larger means agent is more uncertain of client's identity)
γ	1.0	model environment noise variance
γ_d	0.9	discount factor (if needed)
N	300	number of samples (use smallest number possible)

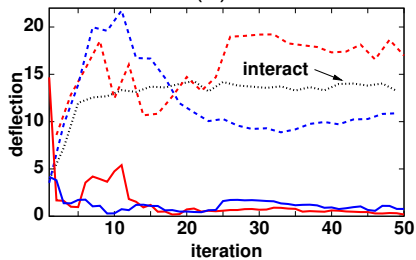
Simulations



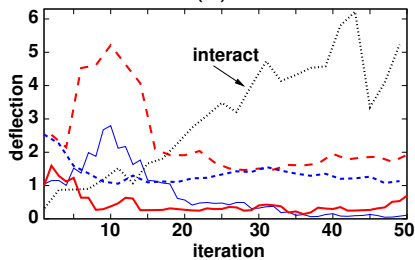
(a)



(b)



(c)

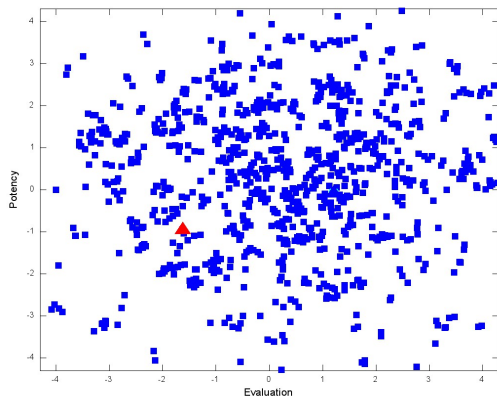


(d)

1. **Agent only knows self identity, Client knows everything**
- 2.
- 3.
- 4.
- 5.
- 6.

Simulations (1)

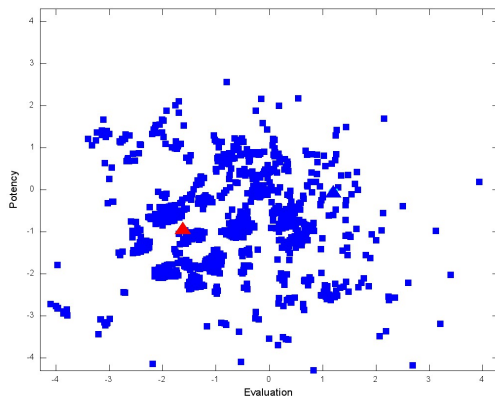
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 1

Simulations (1)

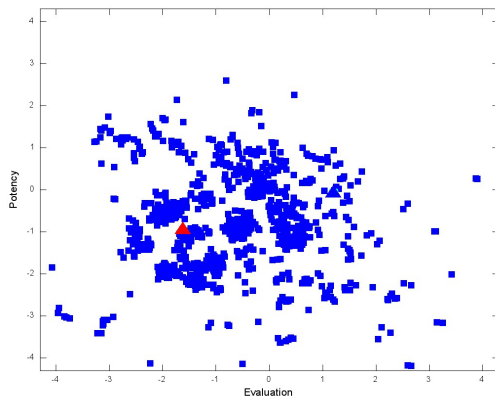
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 2

Simulations (1)

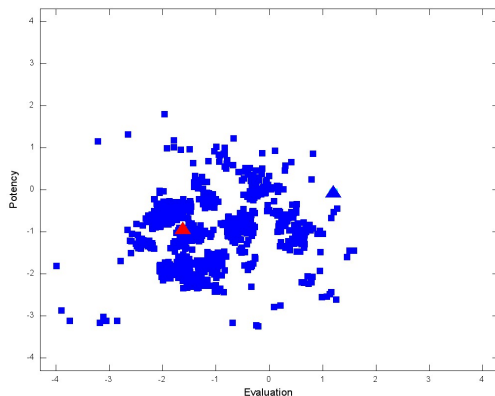
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 3

Simulations (1)

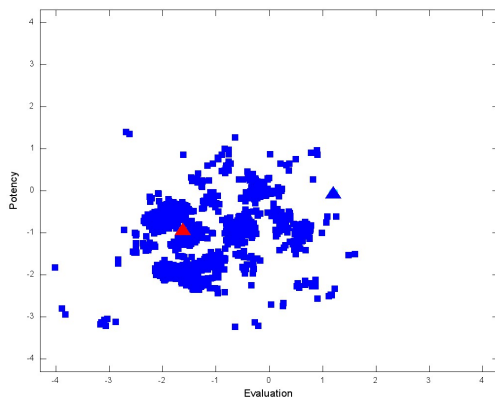
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 4

Simulations (1)

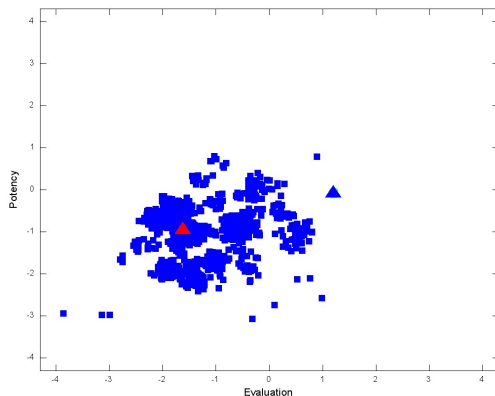
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 5

Simulations (1)

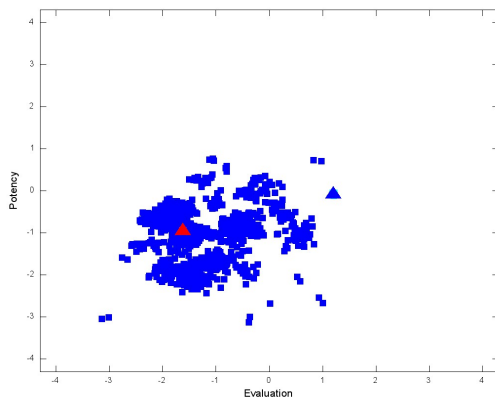
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 6

Simulations (1)

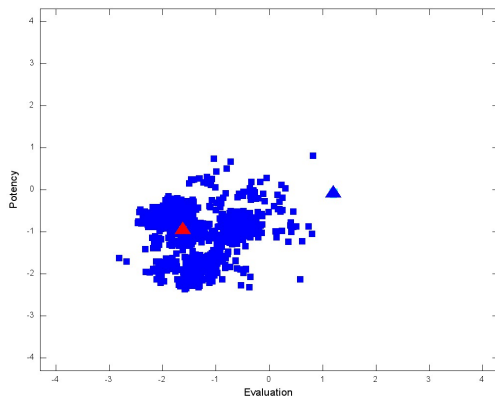
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 7

Simulations (1)

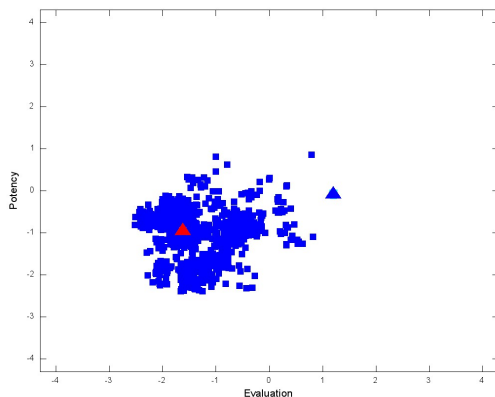
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 8

Simulations (1)

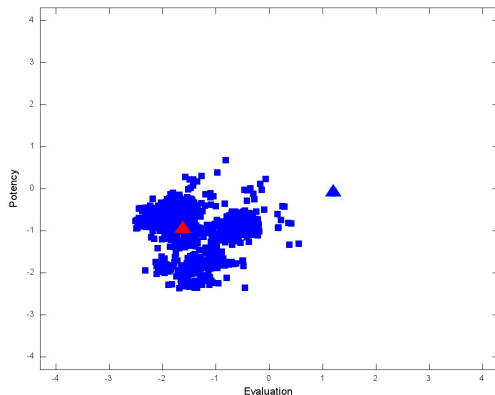
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 9

Simulations (1)

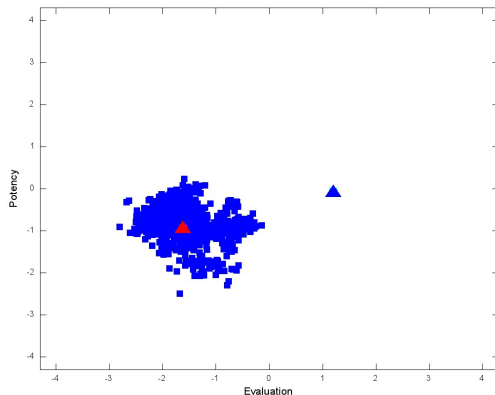
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 10

Simulations (1)

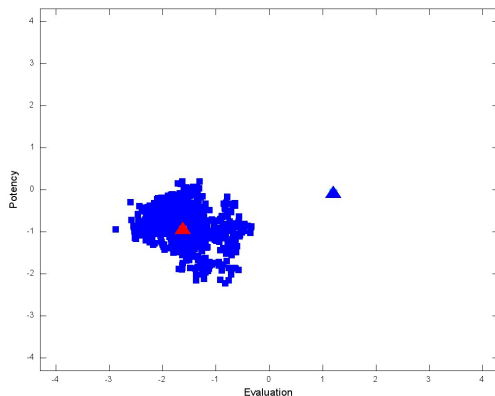
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 20

Simulations (1)

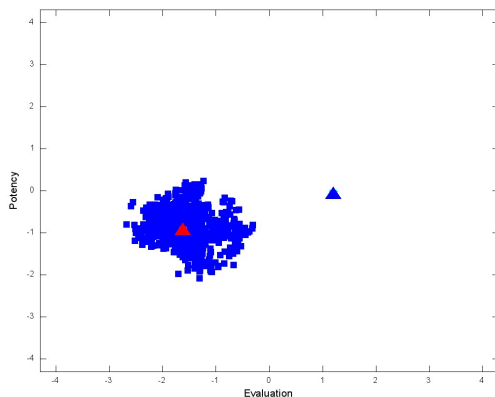
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 21

Simulations (1)

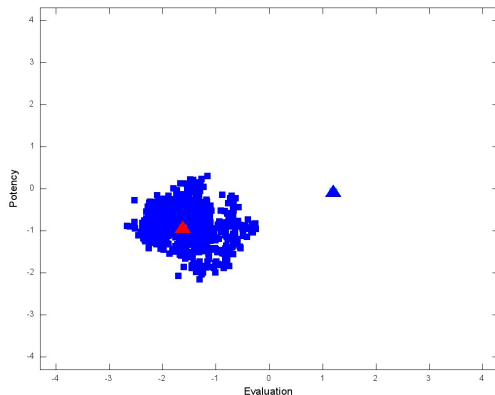
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 22

Simulations (1)

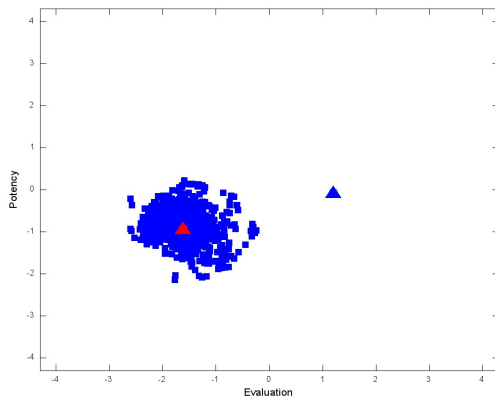
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 23

Simulations (1)

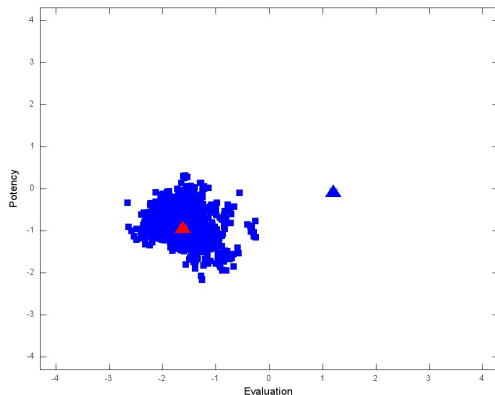
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



frame number: 24

Simulations (1)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	✓	1000	0.0	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.001$	$\beta_c^0 = 0.001$			



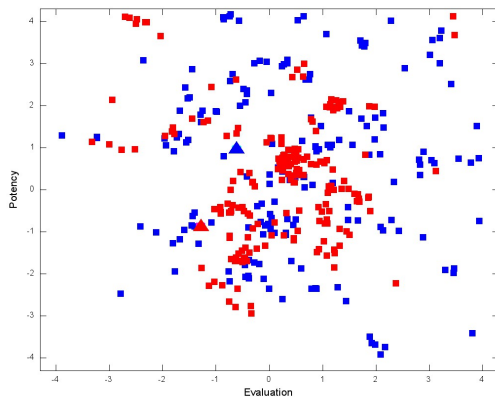
frame number: 25

Simulations

1. Agent only knows self identity, Client knows everything
2. **Agent and Client only know self identity**
- 3.
- 4.
- 5.
- 6.

Simulations (5)

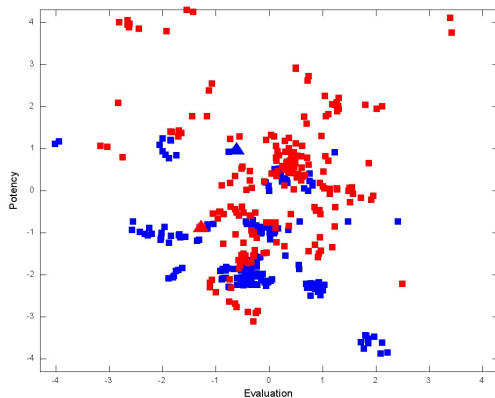
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 1

Simulations (5)

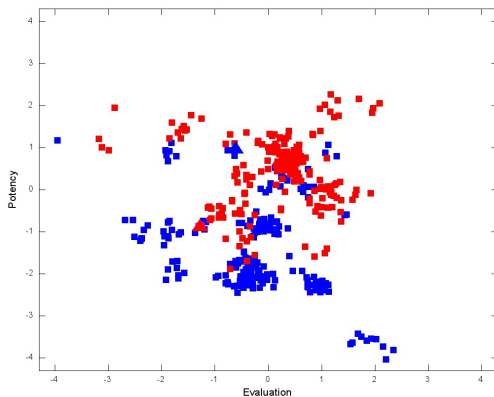
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 2

Simulations (5)

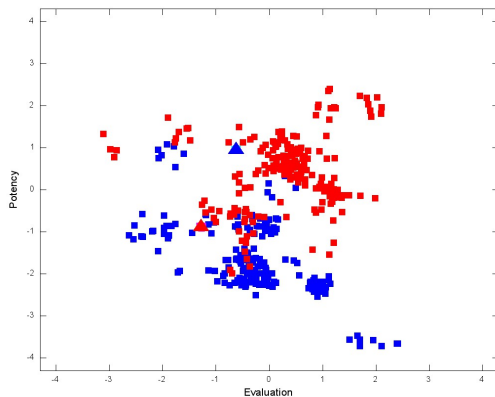
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 3

Simulations (5)

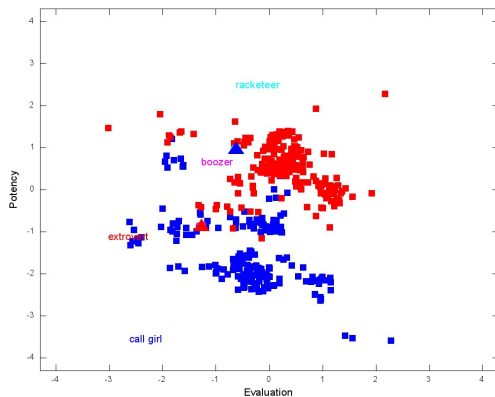
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 4

Simulations (5)

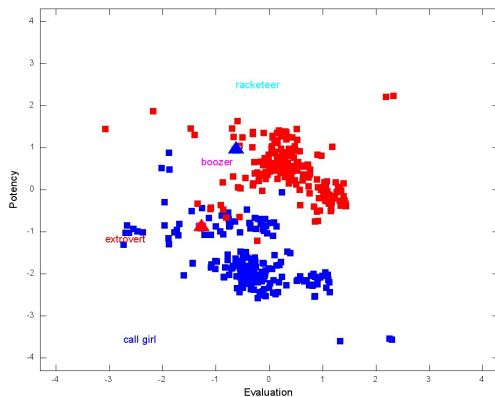
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 5

Simulations (5)

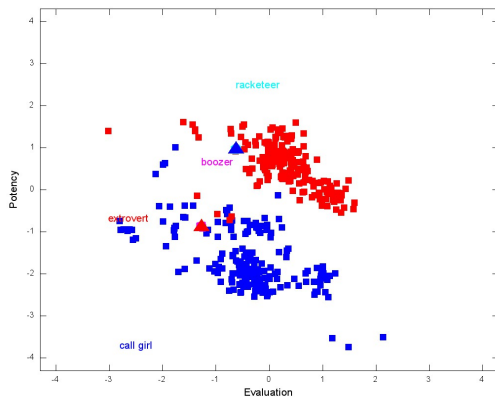
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 6

Simulations (5)

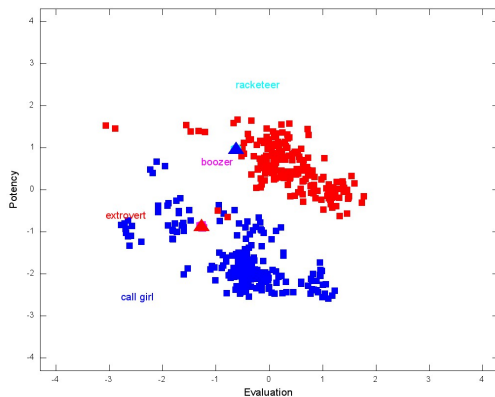
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 7

Simulations (5)

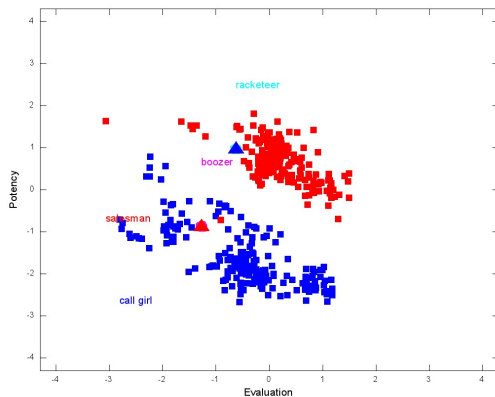
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 8

Simulations (5)

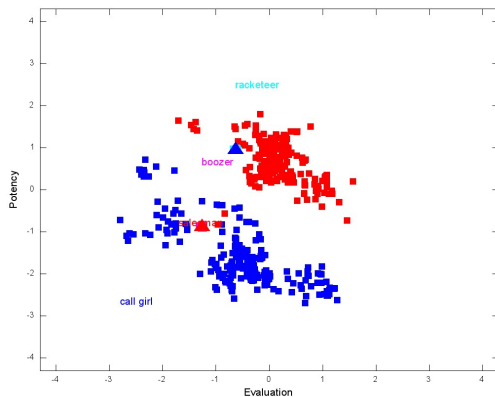
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 9

Simulations (5)

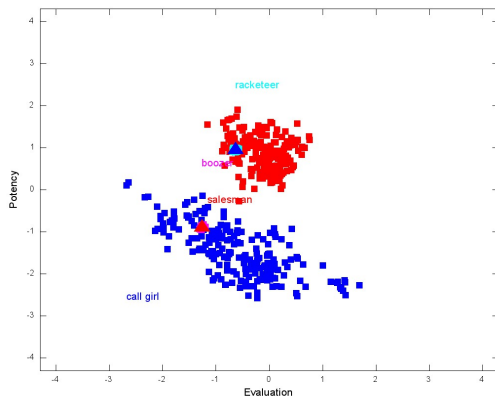
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 10

Simulations (5)

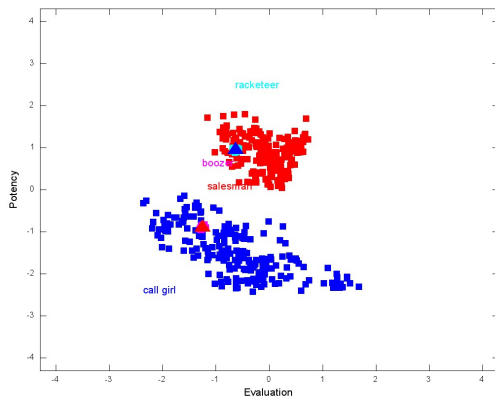
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 21

Simulations (5)

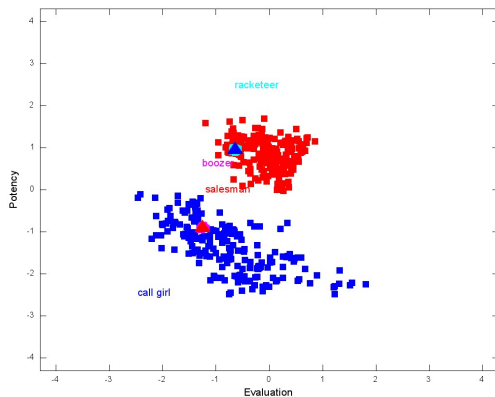
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 22

Simulations (5)

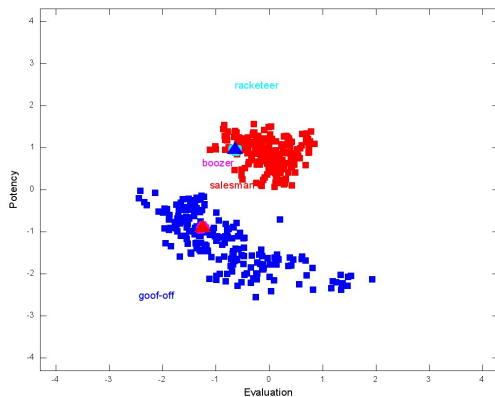
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 23

Simulations (5)

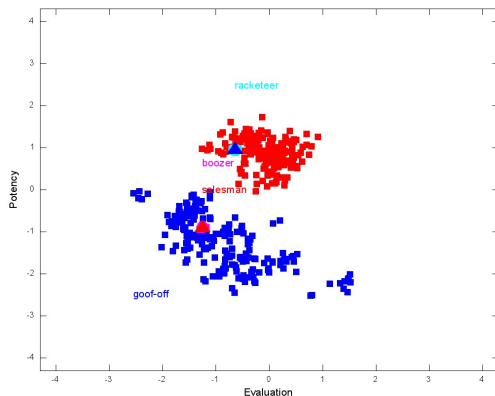
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 24

Simulations (5)

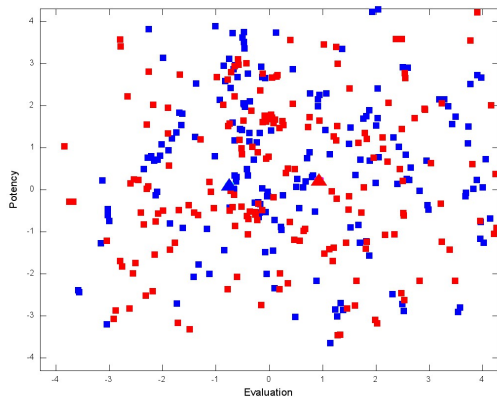
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 25

Simulations (5)

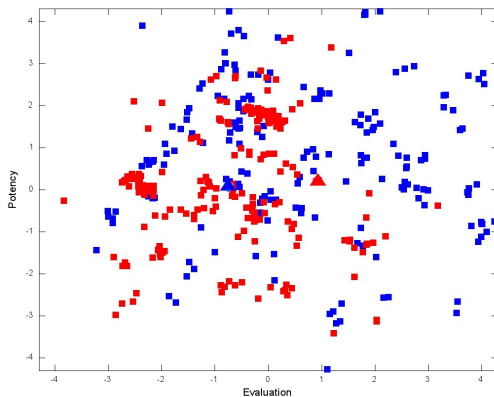
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 50

Simulations (5)

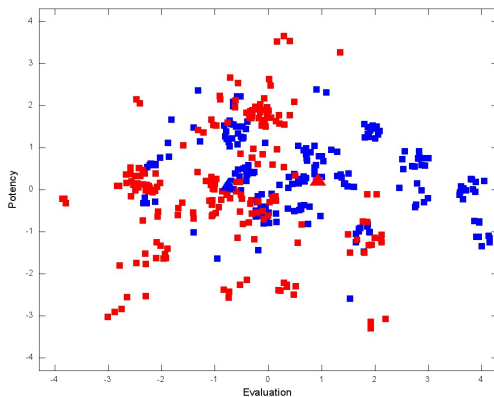
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 51

Simulations (5)

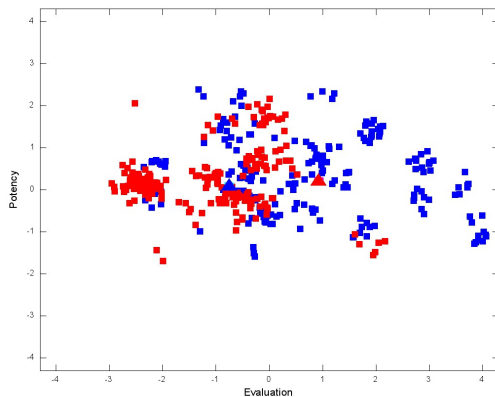
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 52

Simulations (5)

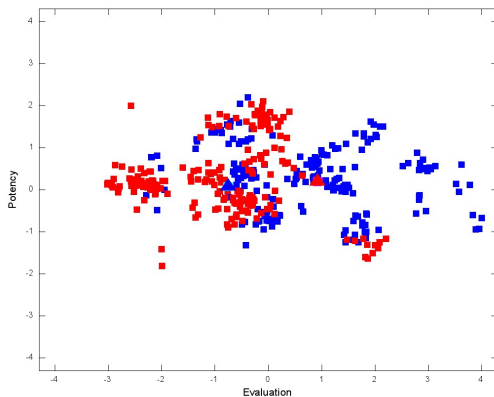
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 53

Simulations (5)

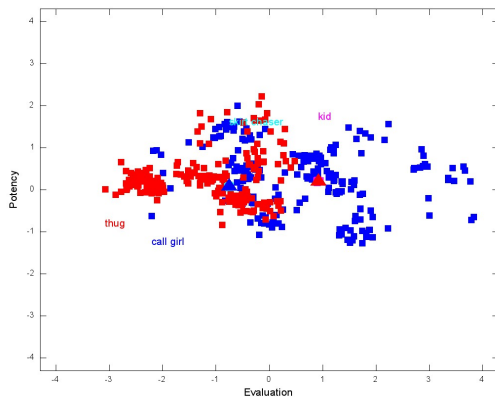
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 54

Simulations (5)

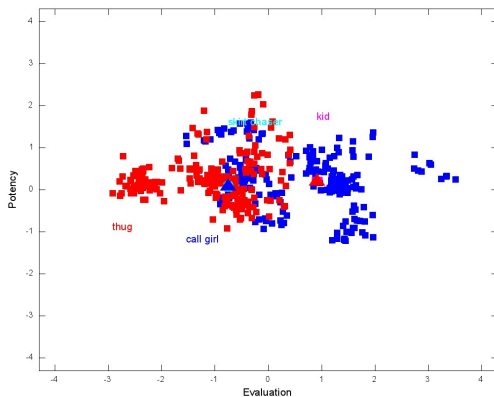
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 55

Simulations (5)

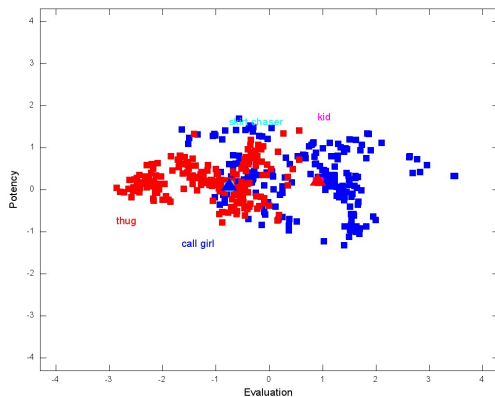
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 56

Simulations (5)

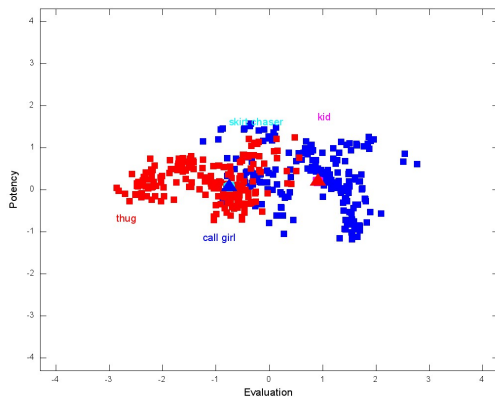
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 57

Simulations (5)

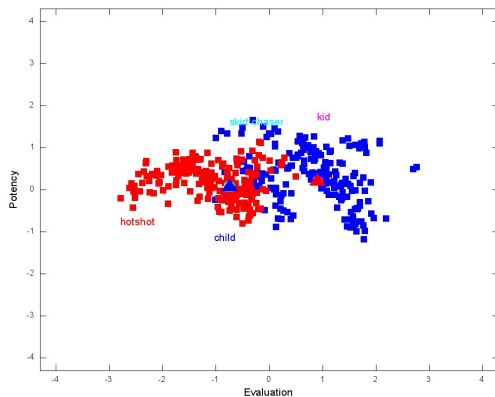
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 58

Simulations (5)

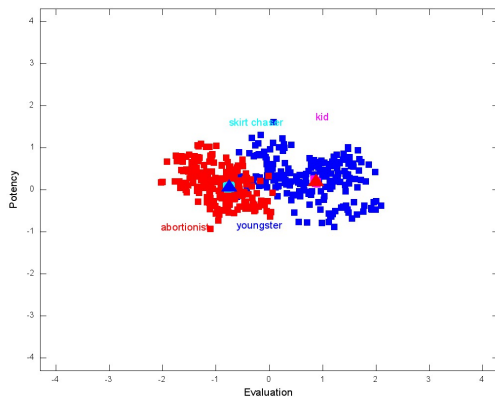
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 59

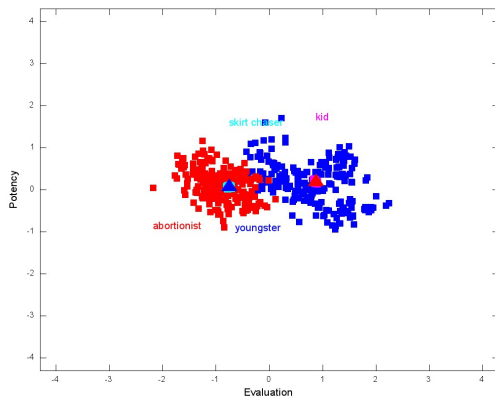
Simulations (5)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



Simulations (5)

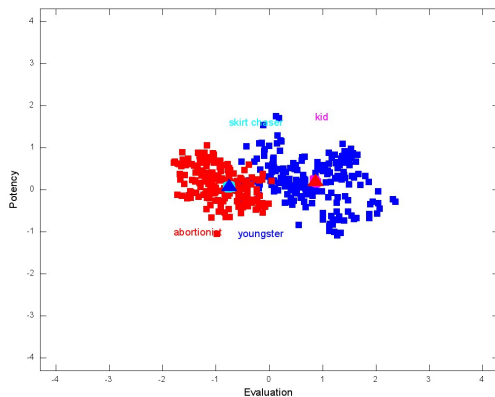
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 72

Simulations (5)

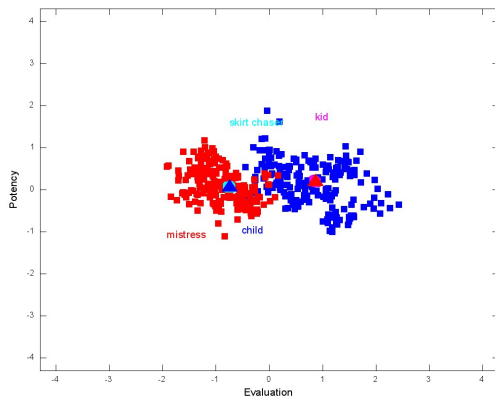
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 73

Simulations (5)

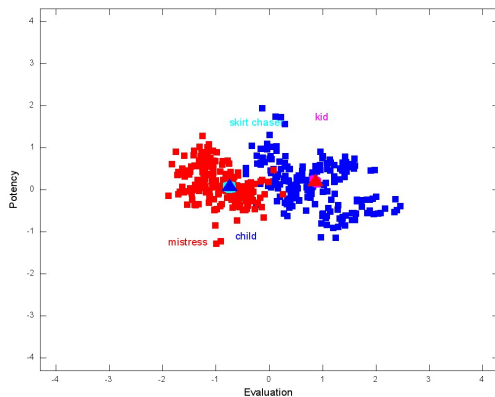
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 74

Simulations (5)

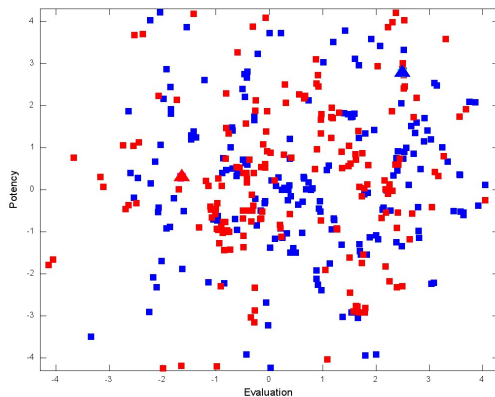
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 75

Simulations (5)

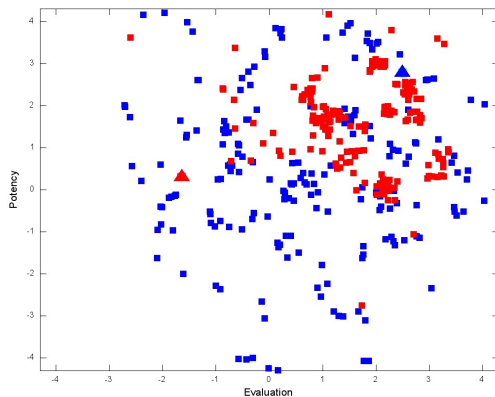
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 300

Simulations (5)

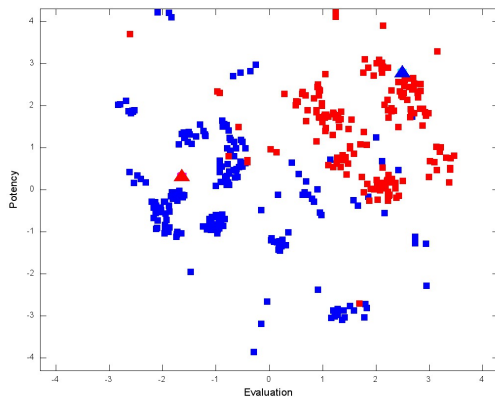
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 301

Simulations (5)

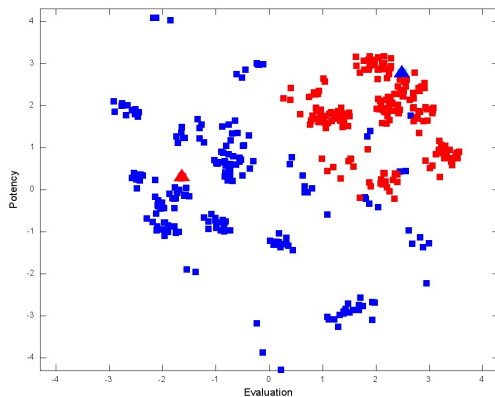
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 302

Simulations (5)

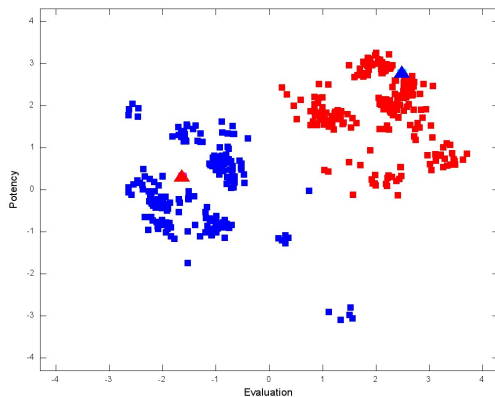
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 303

Simulations (5)

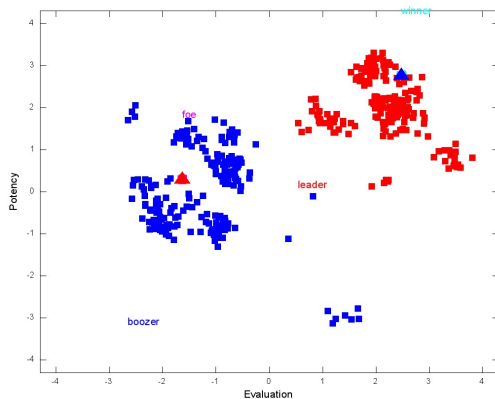
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 304

Simulations (5)

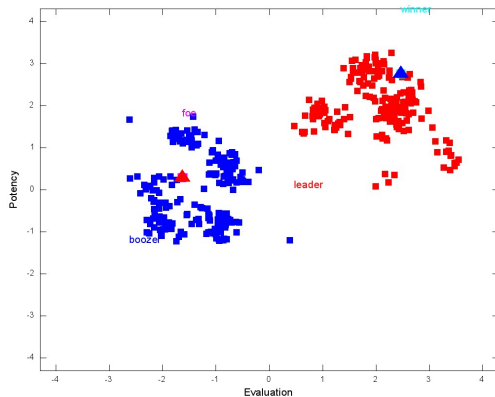
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 305

Simulations (5)

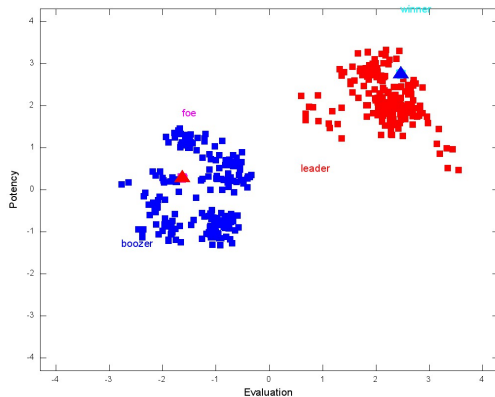
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 306

Simulations (5)

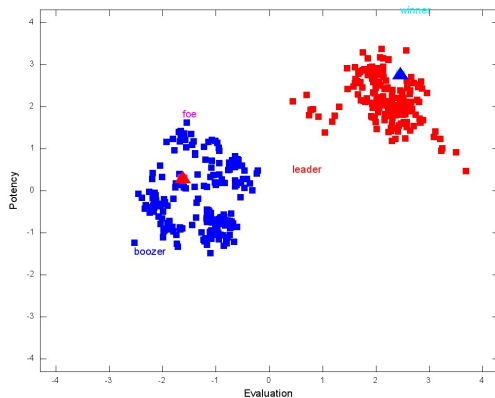
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 307

Simulations (5)

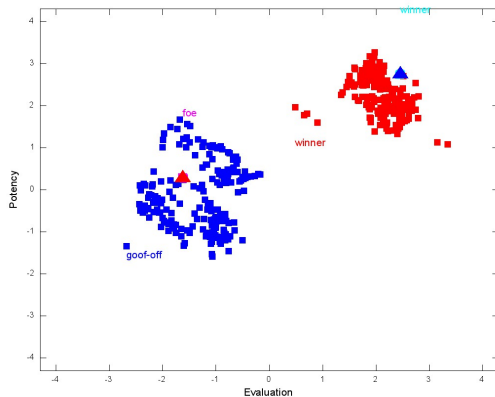
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 308

Simulations (5)

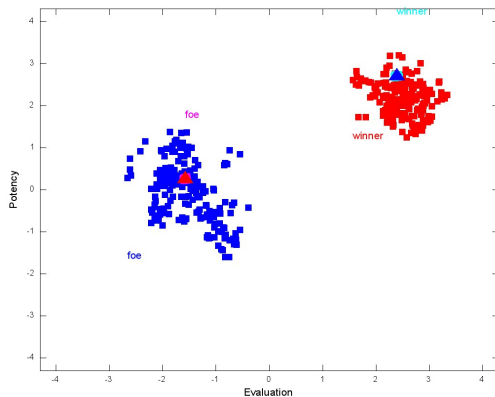
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 309

Simulations (5)

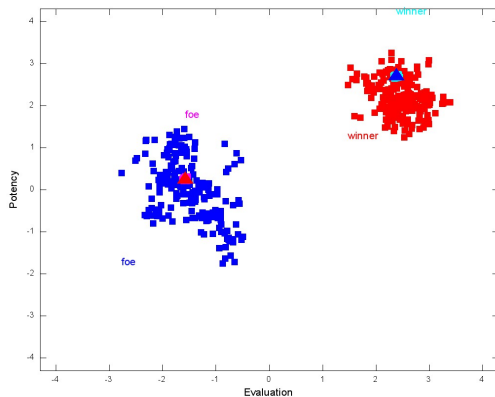
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 321

Simulations (5)

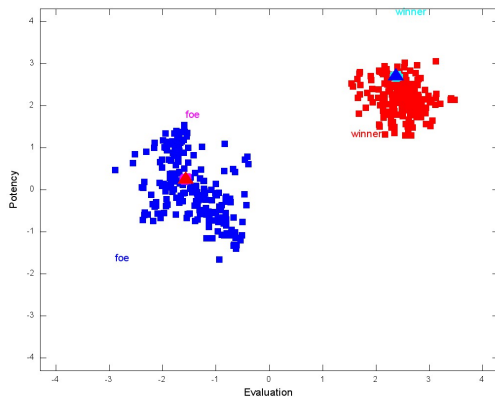
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 322

Simulations (5)

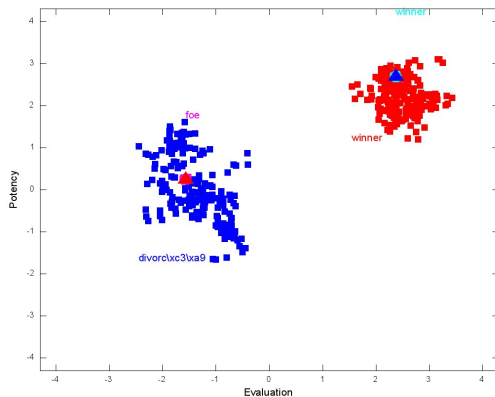
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 323

Simulations (5)

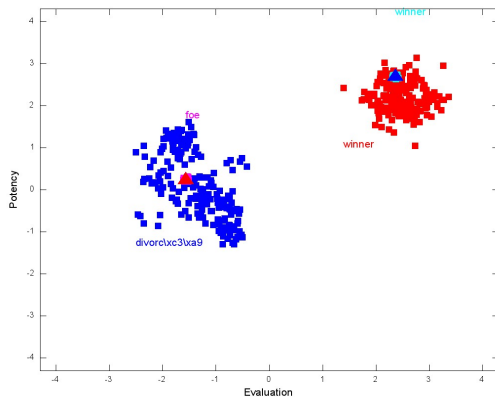
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	x	✓	x	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



frame number: 324

Simulations (5)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓	✗	✓	✗	200	0.1	50
$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$	$\beta_a^0 = 0.01$	$\beta_c^0 = 2.0$			



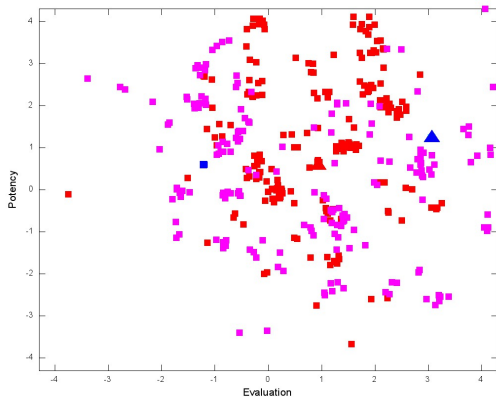
frame number: 325

Simulations

1. Agent only knows self identity, Client knows everything
2. Agent and Client only know self identity
3. **Agent knows everything, Client knows nothing**
- 4.
- 5.
- 6.

Simulations (6)

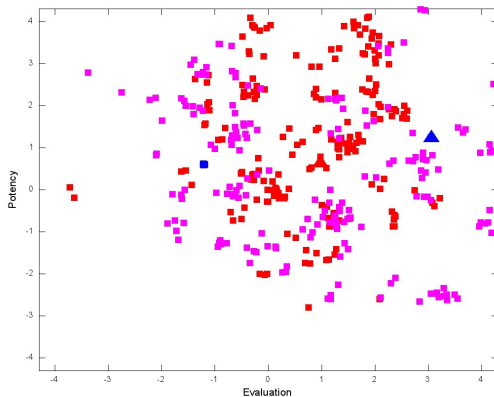
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 1

Simulations (6)

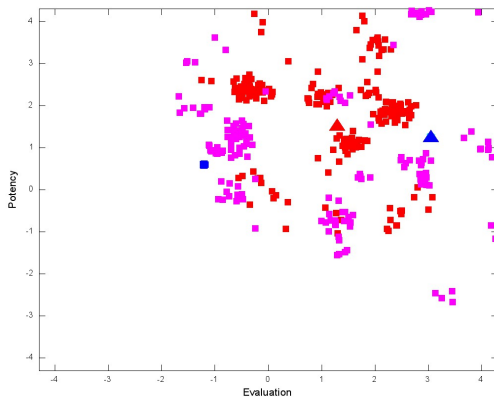
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 2

Simulations (6)

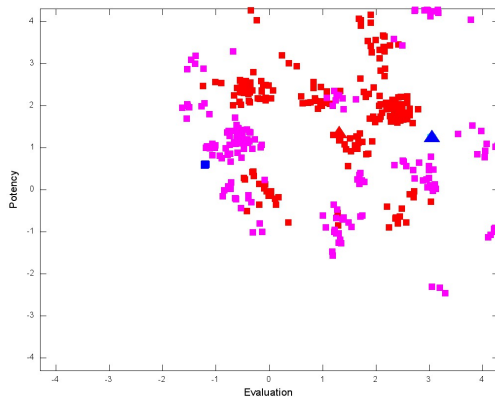
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 3

Simulations (6)

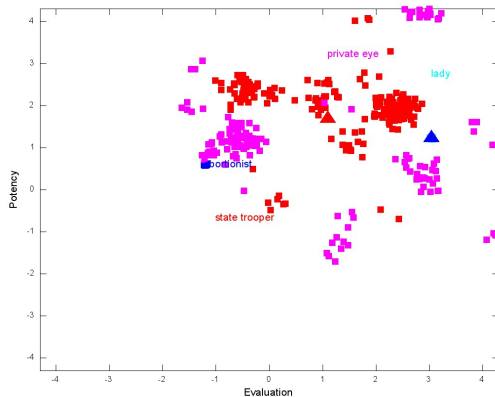
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 4

Simulations (6)

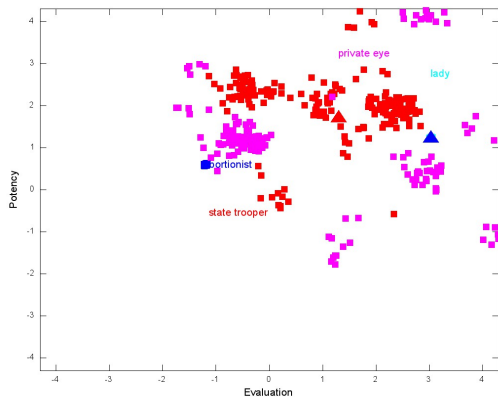
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 5

Simulations (6)

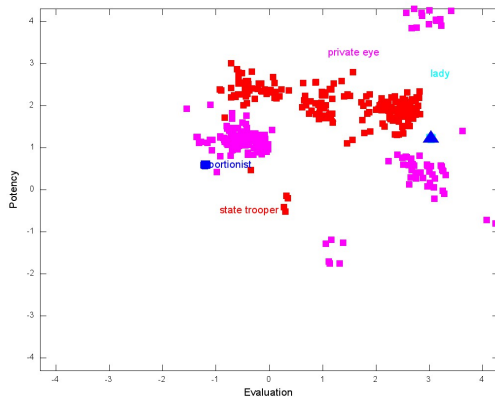
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 6

Simulations (6)

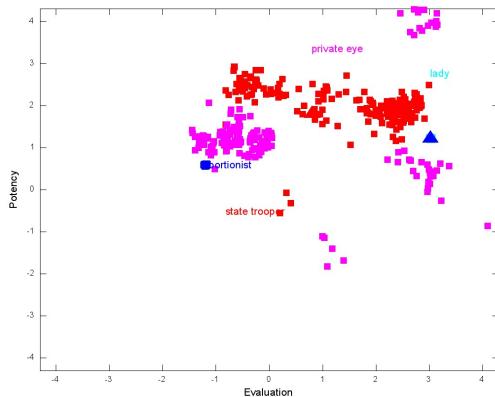
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 7

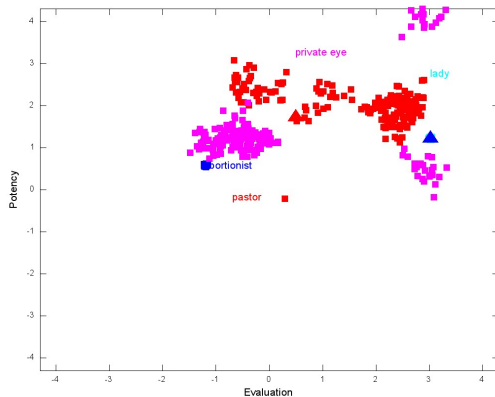
Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



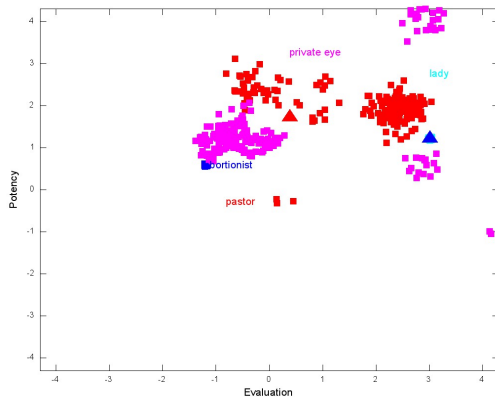
Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



Simulations (6)

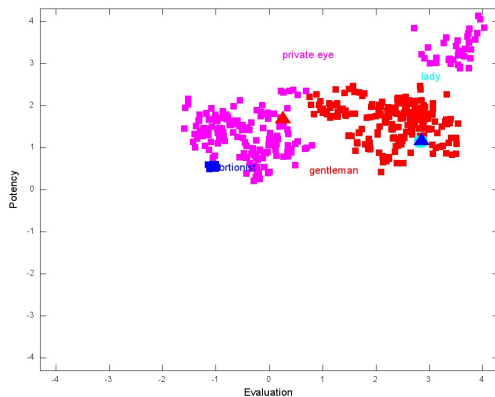
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 10

Simulations (6)

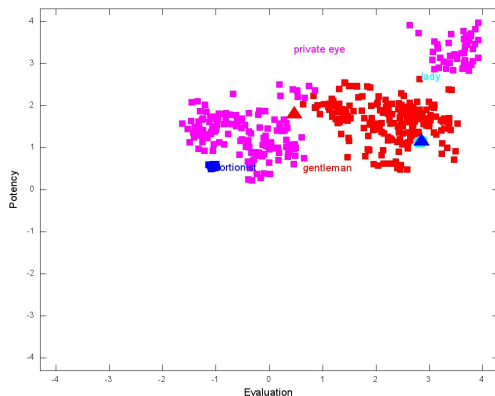
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 41

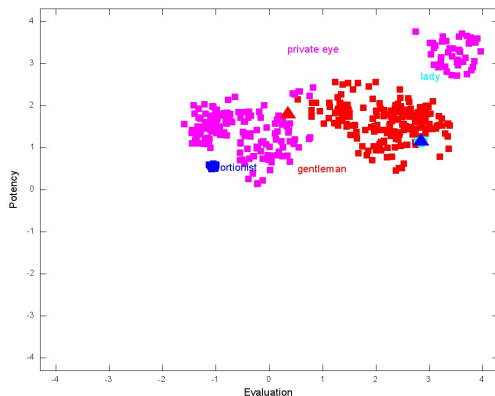
Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



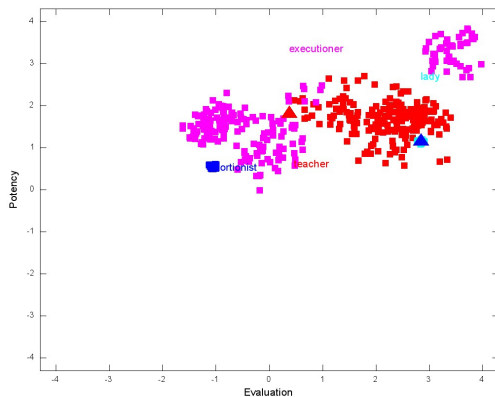
Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



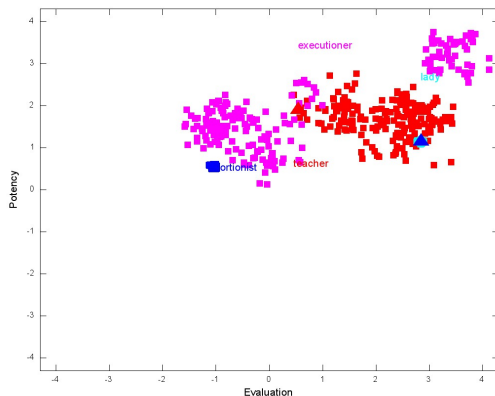
Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



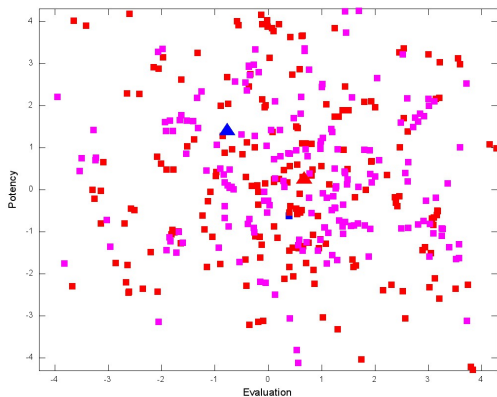
Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



Simulations (6)

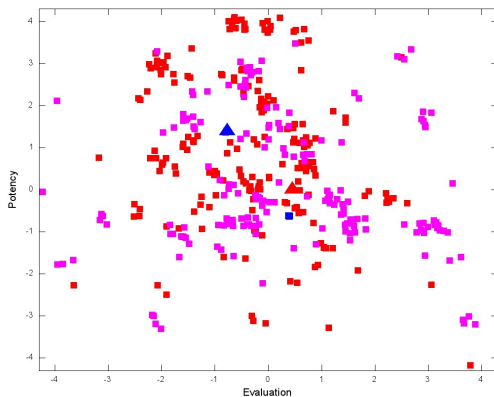
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 150

Simulations (6)

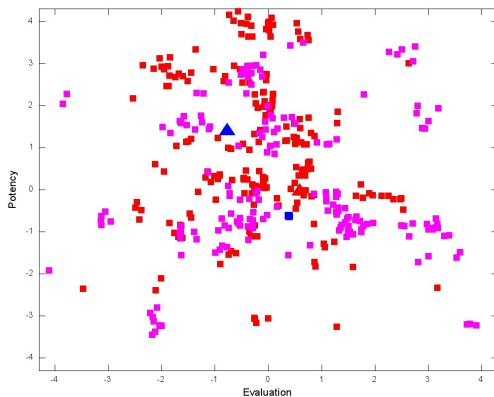
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 151

Simulations (6)

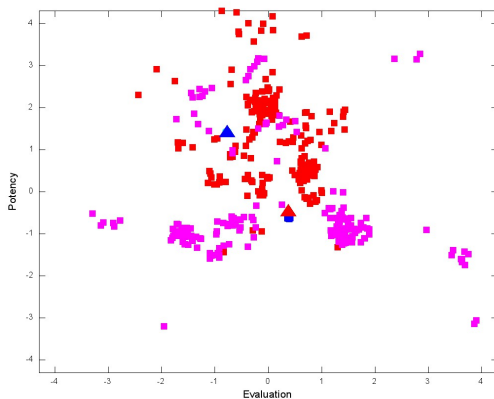
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 152

Simulations (6)

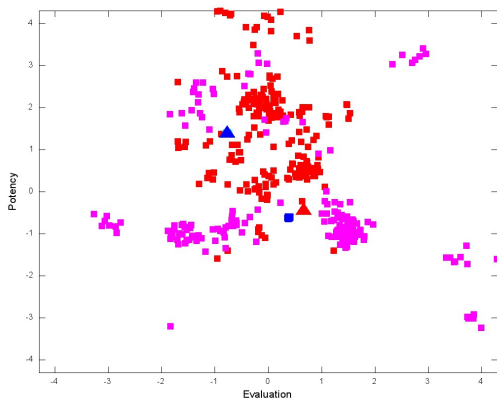
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 153

Simulations (6)

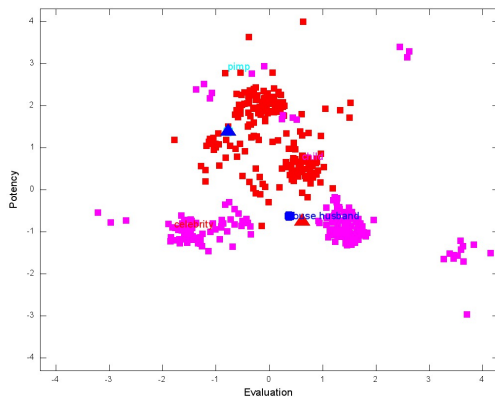
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 154

Simulations (6)

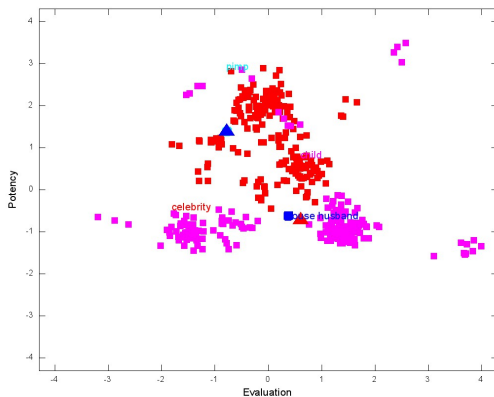
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 155

Simulations (6)

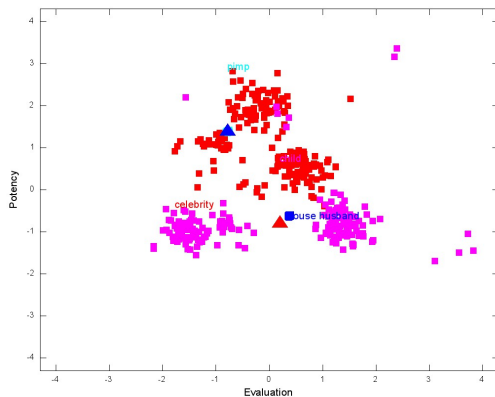
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 156

Simulations (6)

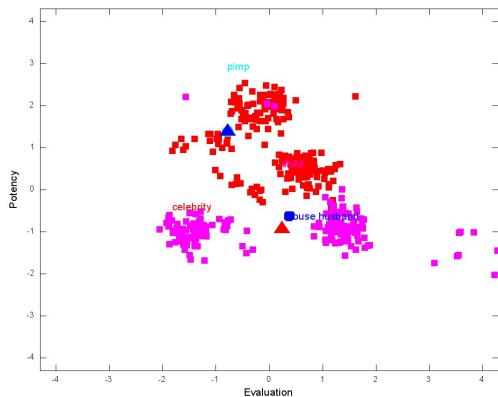
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 157

Simulations (6)

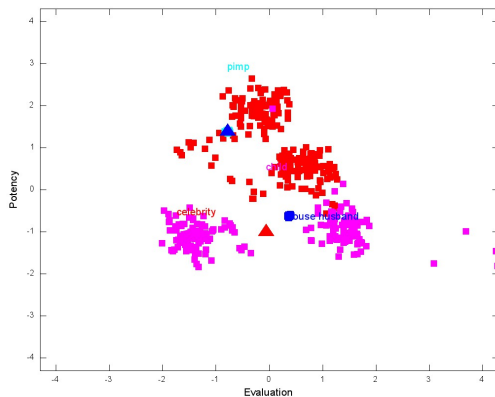
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 158

Simulations (6)

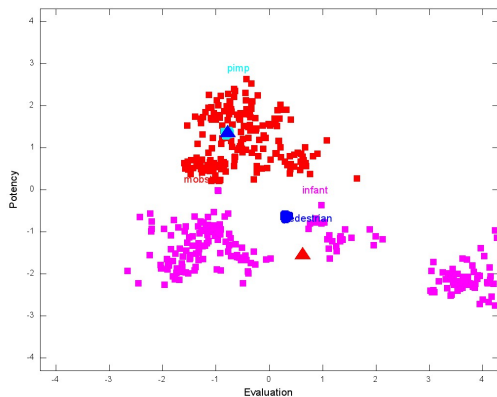
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 159

Simulations (6)

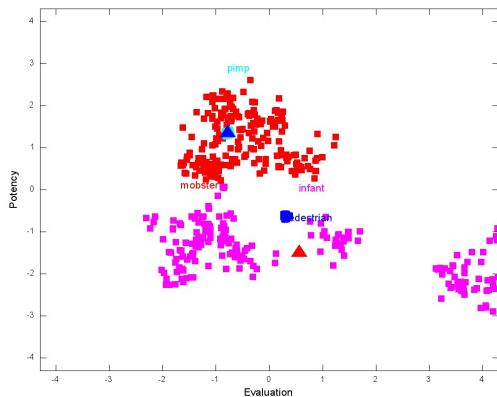
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 191

Simulations (6)

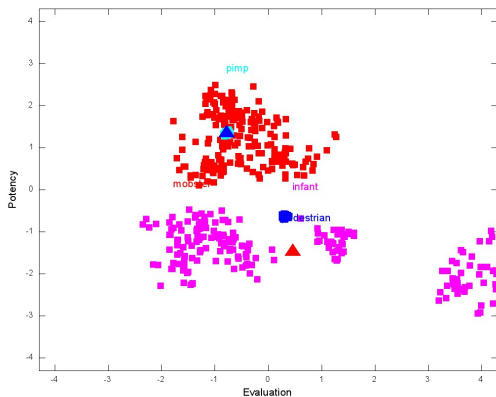
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 192

Simulations (6)

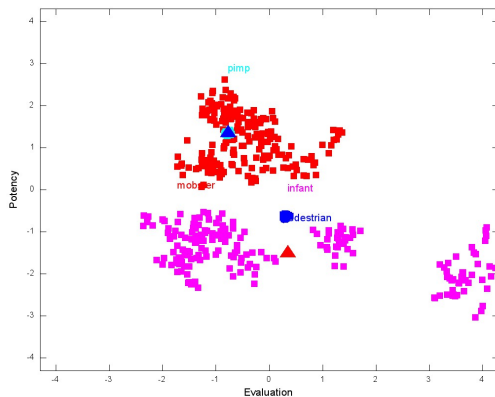
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 193

Simulations (6)

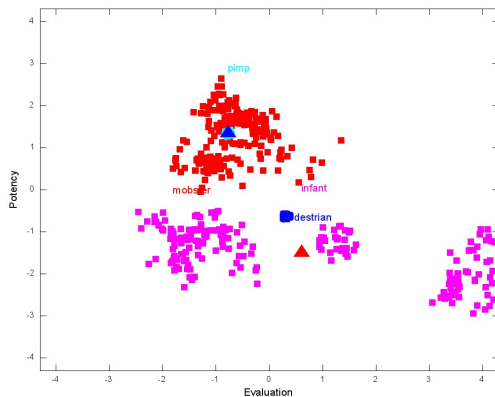
agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



frame number: 194

Simulations (6)

agent		client		N_s	σ_e	h
agent	client	client	agent			
✓ $\beta_a^0 = 0.001$	✓ $\beta_c^0 = 0.001$	✗ $\beta_a^0 = 2.0$	✗ $\beta_c^0 = 2.0$	200	0.1	50



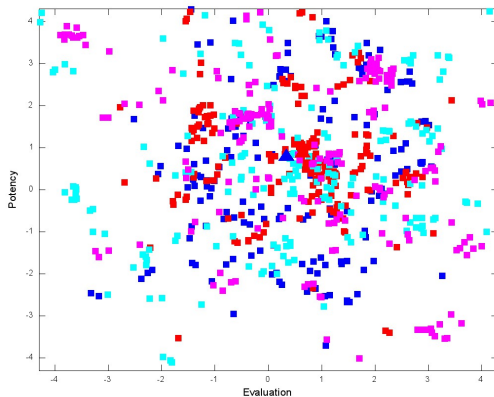
frame number: 195

Simulations

1. Agent only knows self identity, Client knows everything
2. Agent and Client only know self identity
3. Agent knows everything, Client knows nothing
4. Agent only knows self identity, Client knows nothing
5. **Agent and client know nothing**
- 6.

Simulations (8)

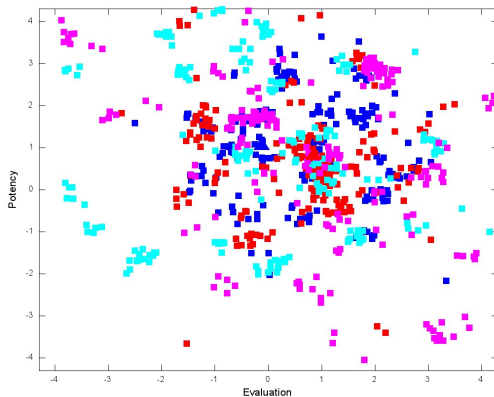
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 1

Simulations (8)

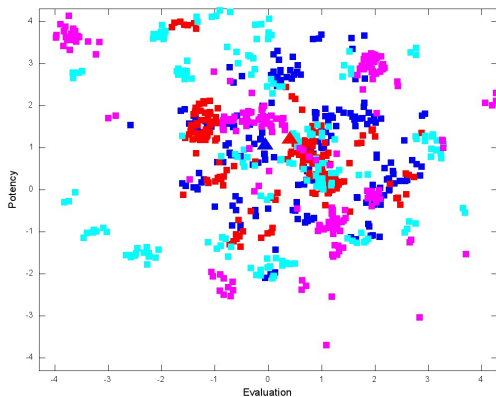
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 2

Simulations (8)

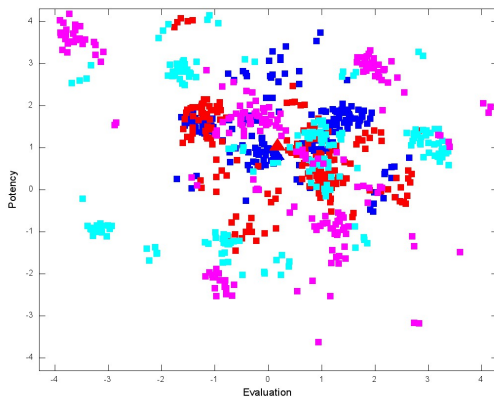
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 3

Simulations (8)

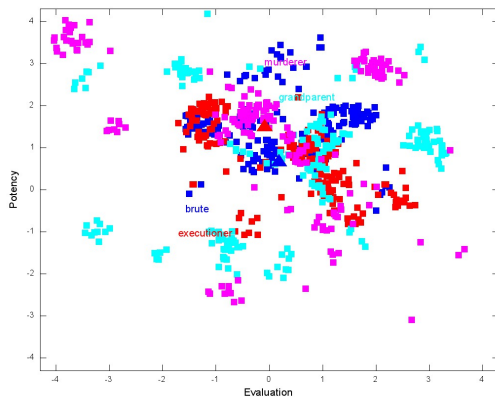
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 4

Simulations (8)

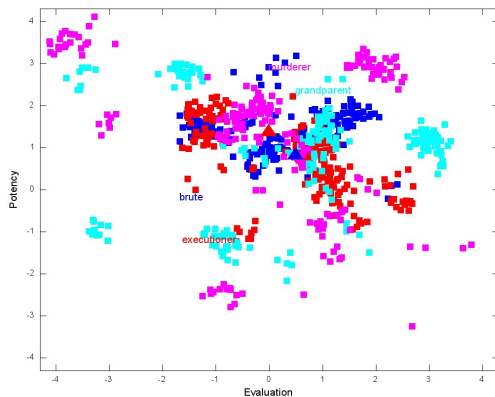
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 5

Simulations (8)

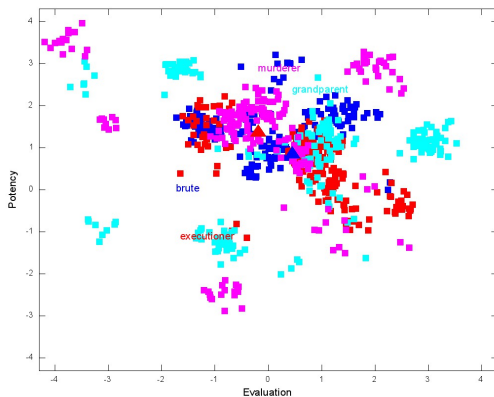
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 6

Simulations (8)

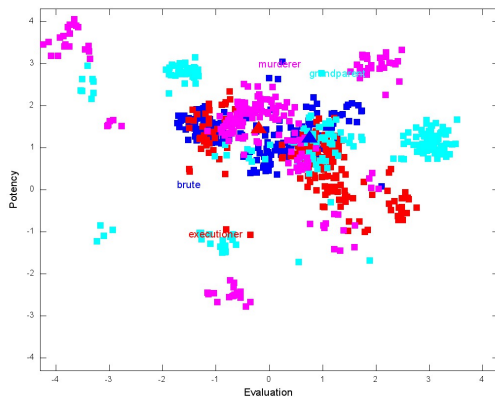
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 7

Simulations (8)

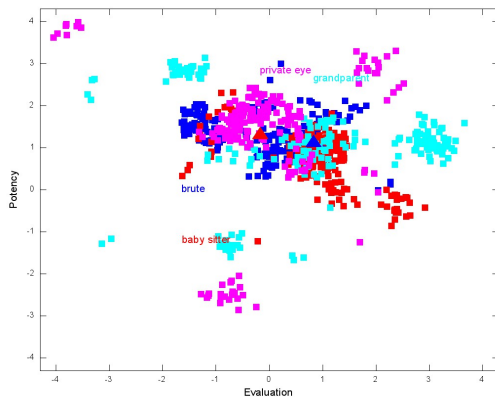
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 8

Simulations (8)

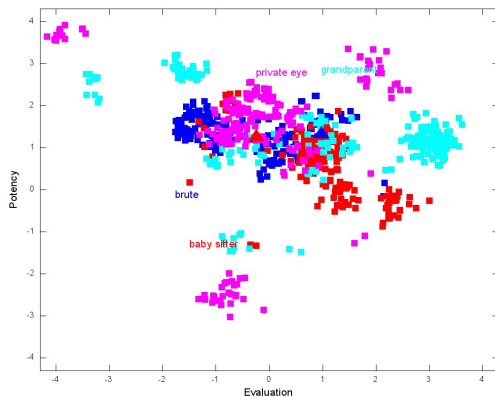
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 9

Simulations (8)

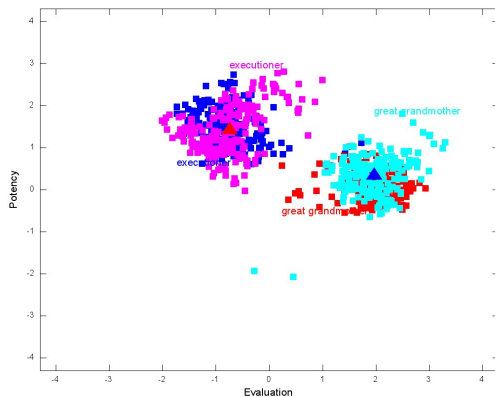
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 10

Simulations (8)

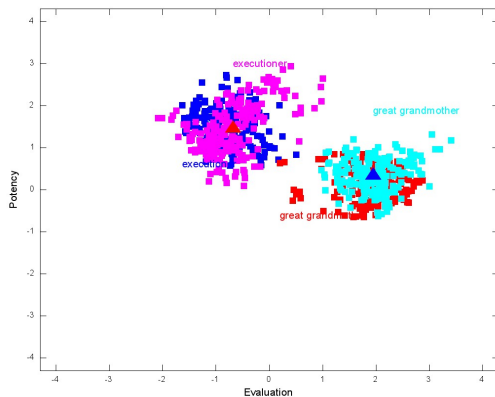
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 71

Simulations (8)

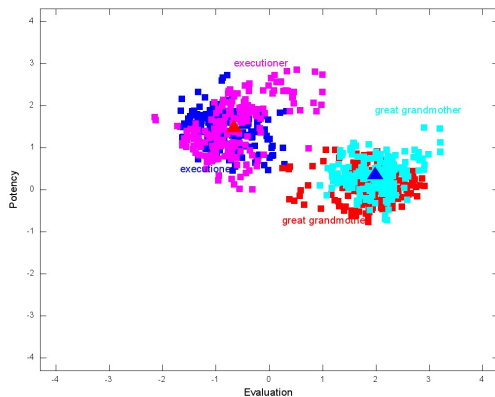
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 72

Simulations (8)

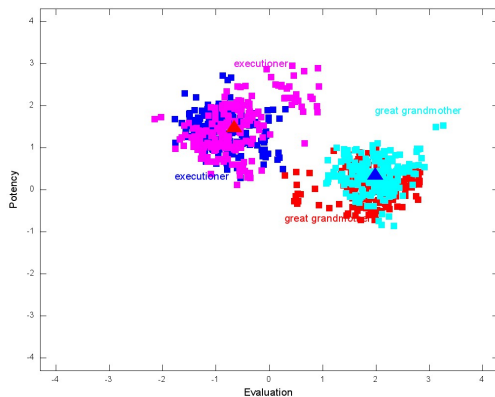
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 73

Simulations (8)

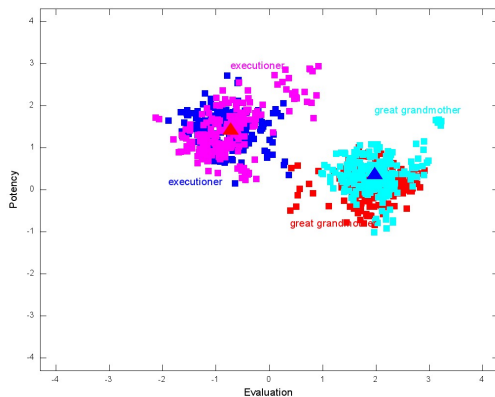
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 74

Simulations (8)

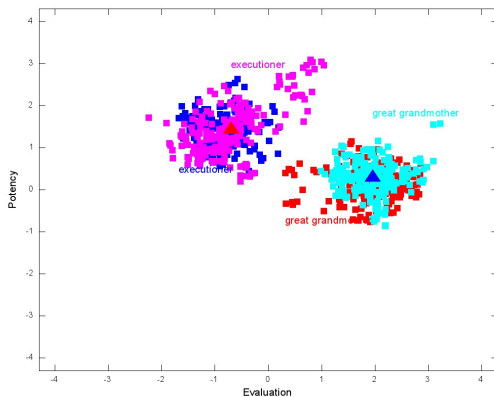
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 75

Simulations (8)

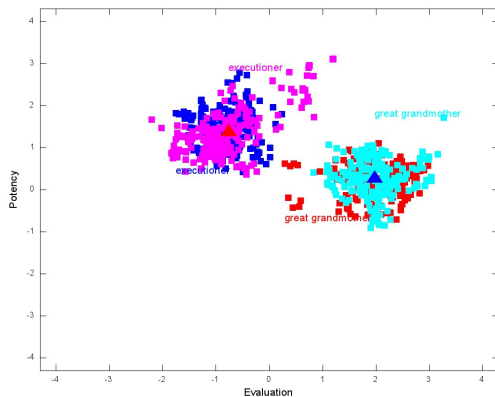
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 76

Simulations (8)

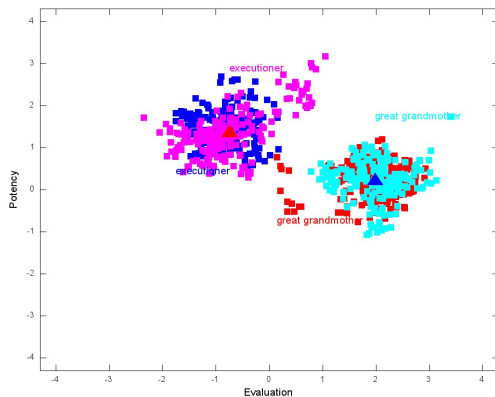
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 77

Simulations (8)

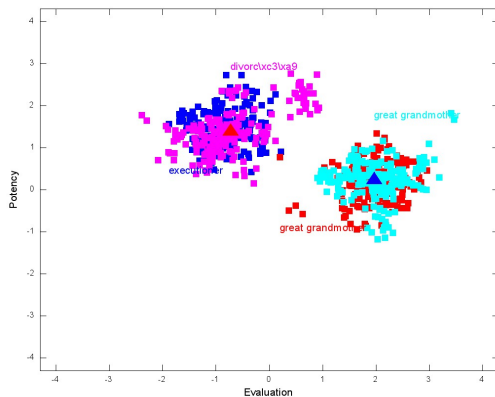
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 78

Simulations (8)

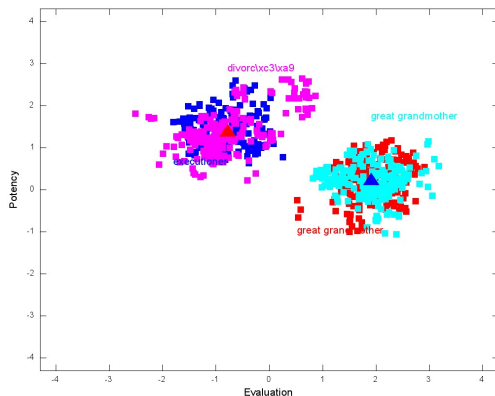
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 79

Simulations (8)

agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.1	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



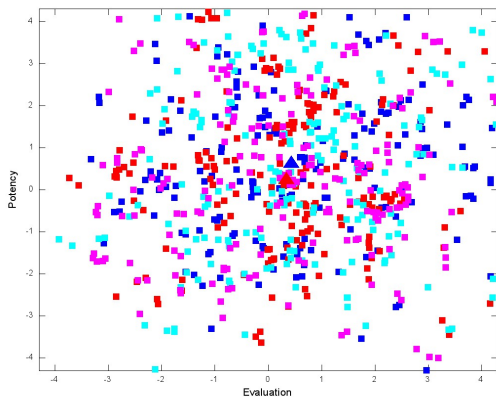
frame number: 80

Simulations

1. Agent only knows self identity, Client knows everything
2. Agent and Client only know self identity
3. Agent knows everything, Client knows nothing
4. Agent only knows self identity, Client knows nothing
5. Agent and client know nothing
6. **Agent and client know nothing (less noise)**

Simulations (8b)

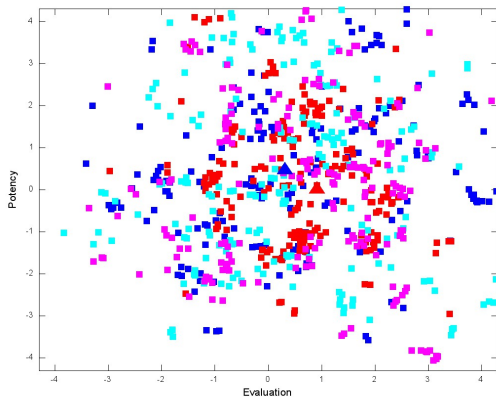
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X			
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	200	0.01	150



frame number: 300

Simulations (8b)

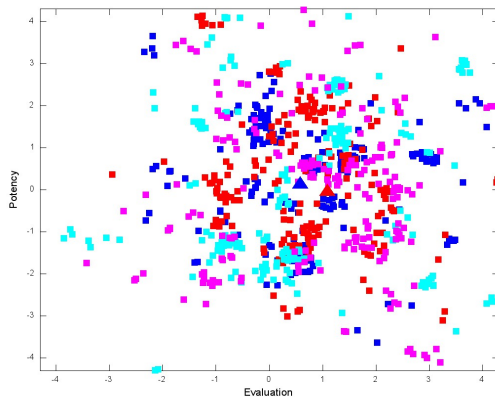
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 301

Simulations (8b)

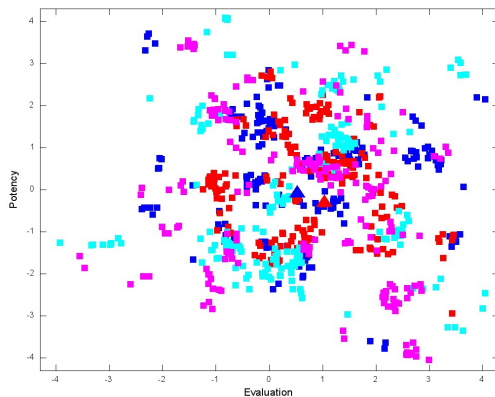
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 302

Simulations (8b)

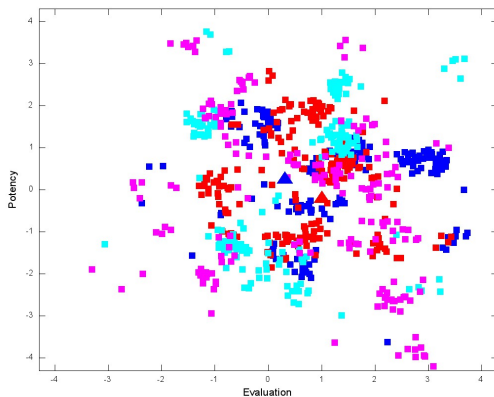
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 303

Simulations (8b)

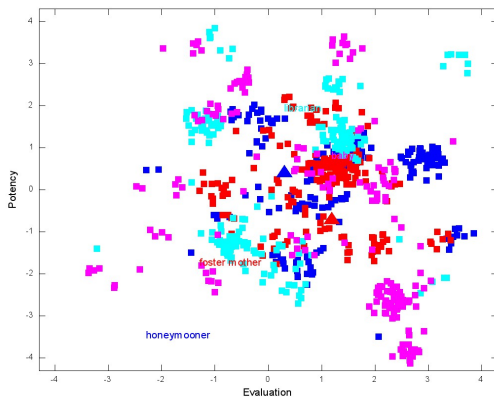
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 304

Simulations (8b)

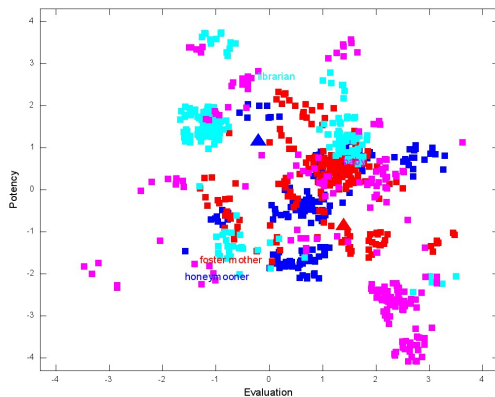
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 305

Simulations (8b)

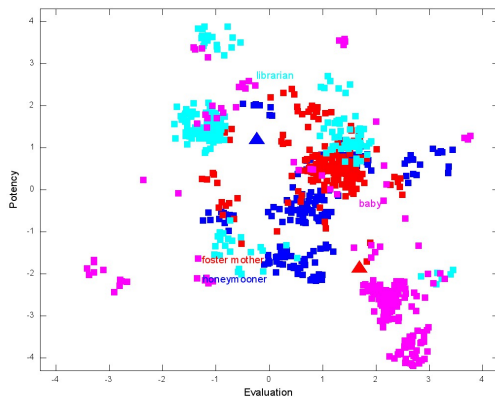
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 306

Simulations (8b)

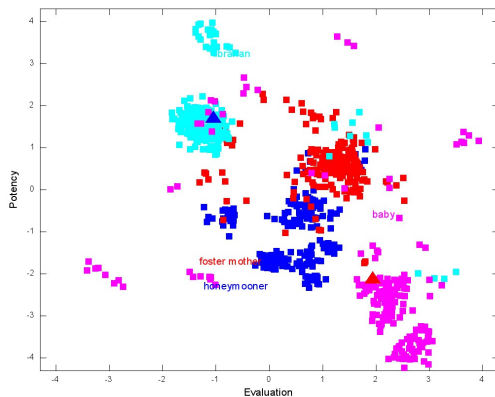
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X			
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	200	0.01	150



frame number: 307

Simulations (8b)

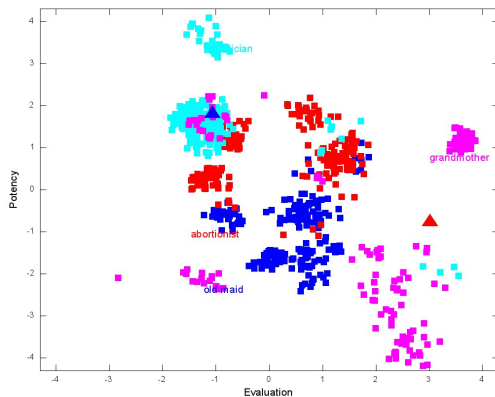
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X			
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	200	0.01	150



frame number: 308

Simulations (8b)

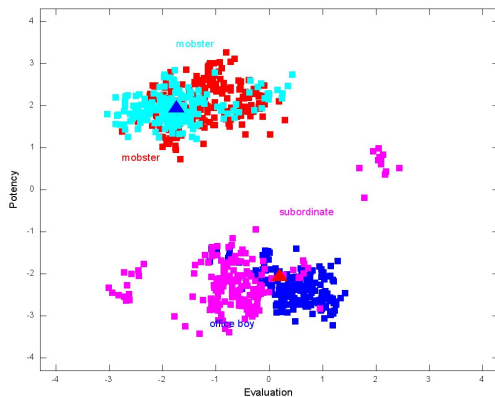
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 309

Simulations (8b)

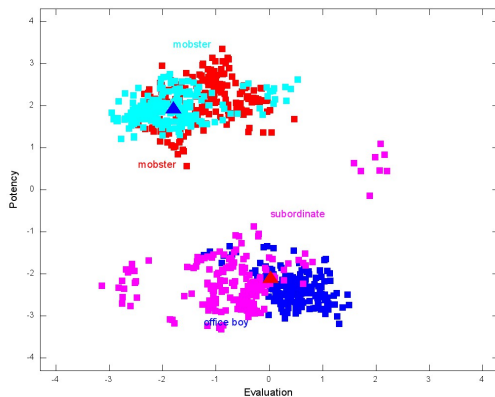
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 381

Simulations (8b)

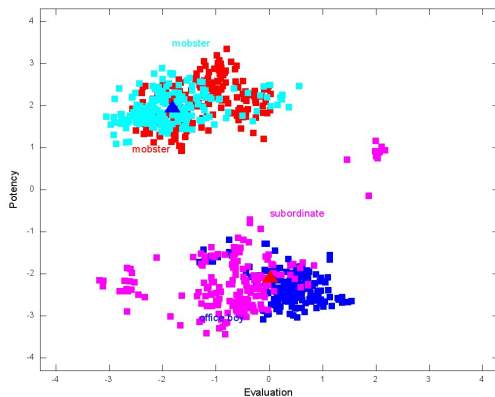
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X			
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	200	0.01	150



frame number: 382

Simulations (8b)

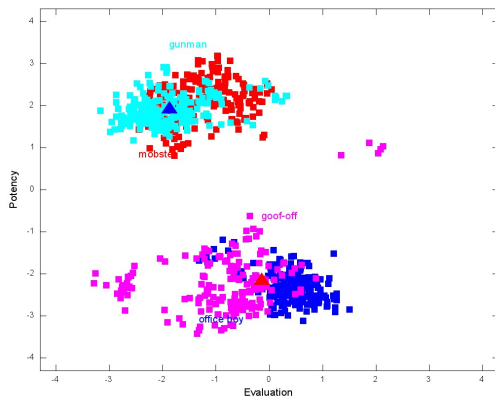
agent		client		N_s	σ_e	h
agent	client	client	agent			
X	X	X	X	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 383

Simulations (8b)

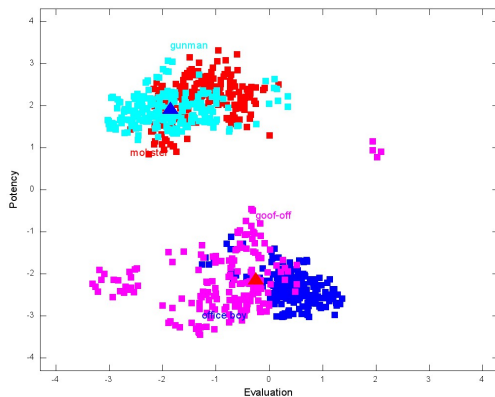
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 384

Simulations (8b)

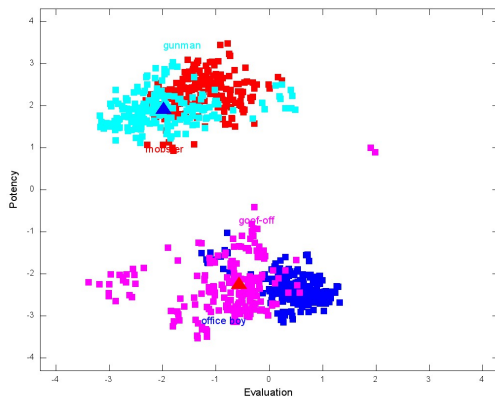
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 385

Simulations (8b)

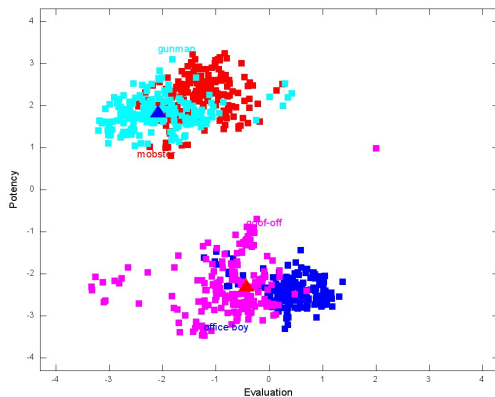
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 386

Simulations (8b)

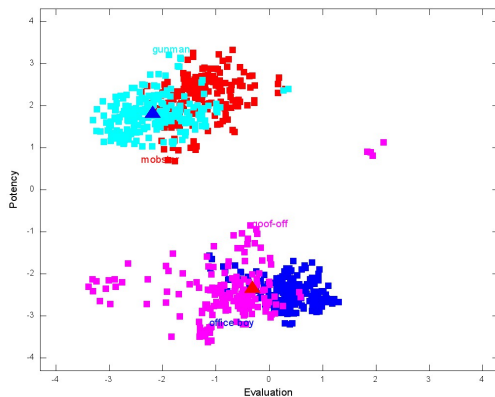
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 387

Simulations (8b)

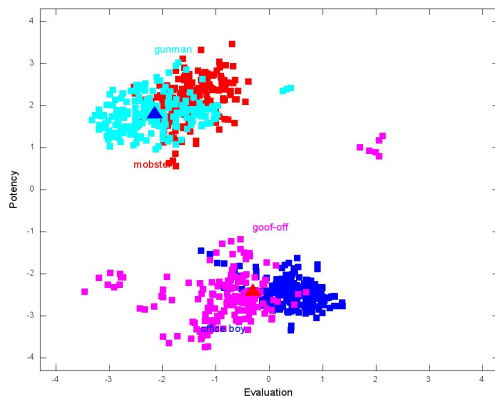
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 388

Simulations (8b)

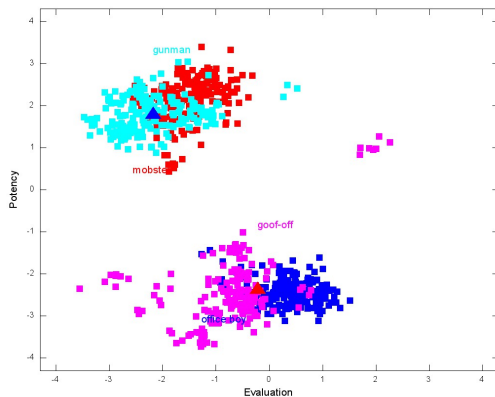
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 389

Simulations (8b)

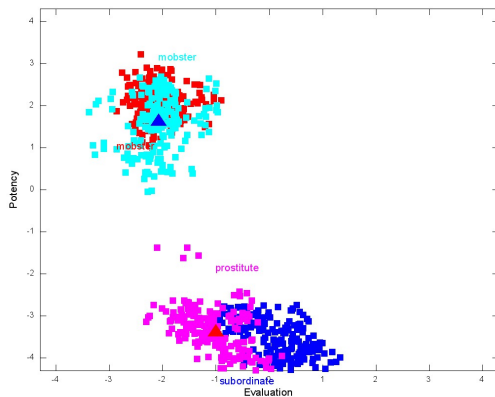
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 390

Simulations (8b)

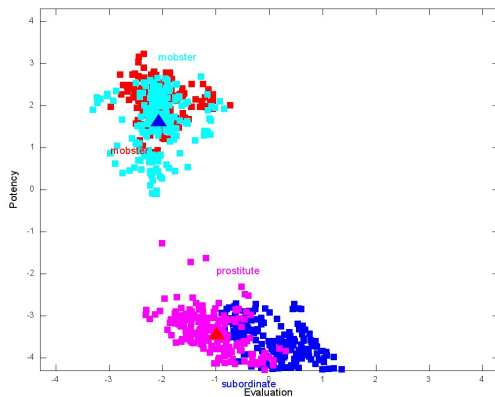
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 441

Simulations (8b)

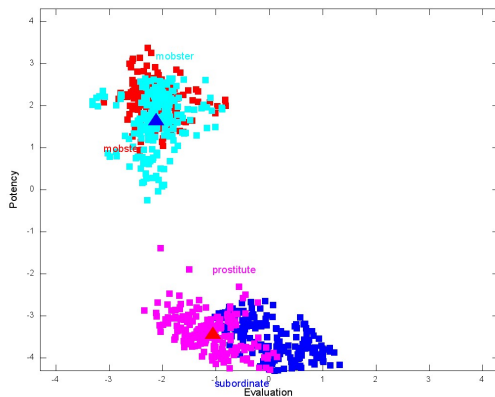
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 442

Simulations (8b)

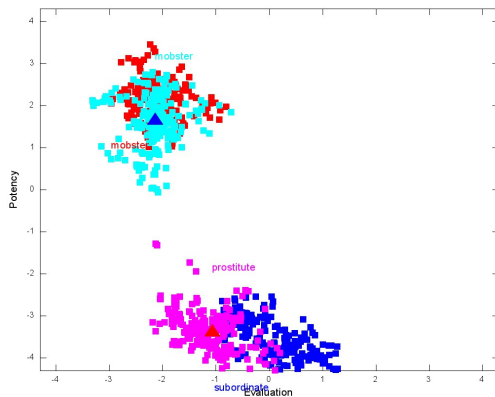
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 443

Simulations (8b)

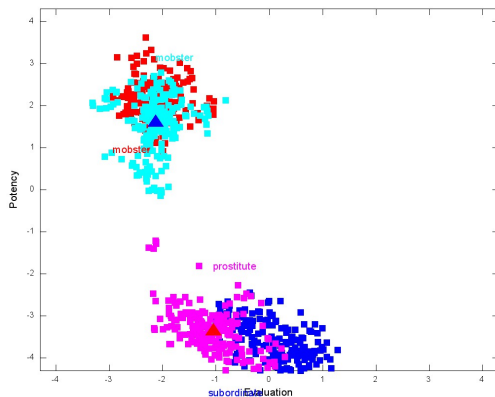
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 444

Simulations (8b)

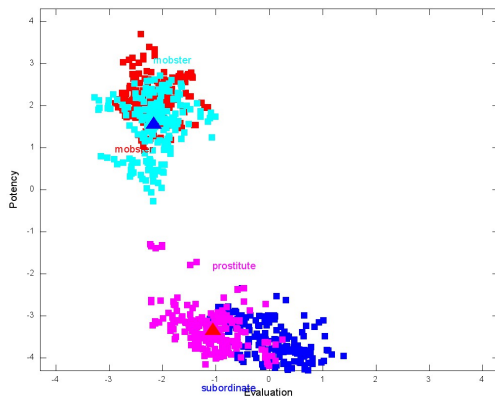
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 445

Simulations (8b)

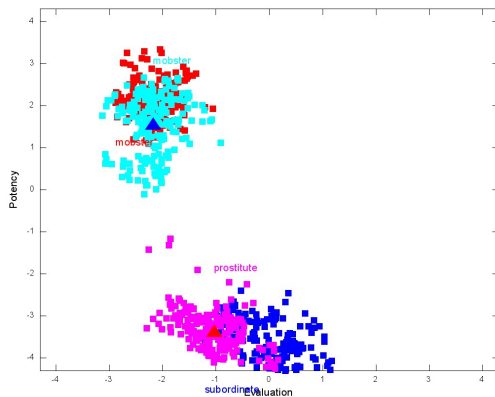
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 446

Simulations (8b)

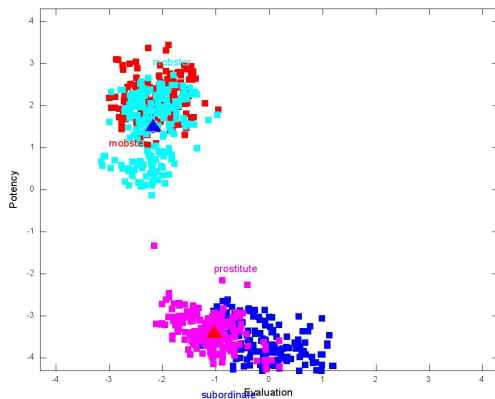
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 447

Simulations (8b)

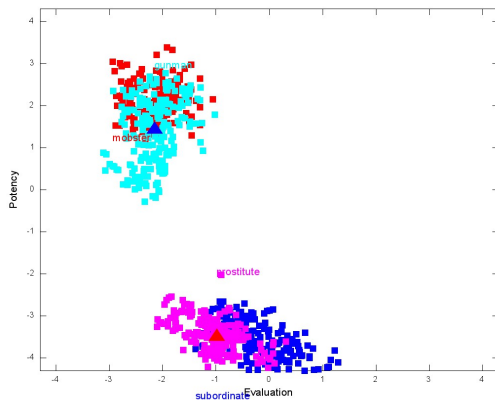
agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 448

Simulations (8b)

agent		client		N_s	σ_e	h
agent	client	client	agent			
x	x	x	x	200	0.01	150
$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$	$\beta_a^0 = 2.0$	$\beta_c^0 = 2.0$			



frame number: 449

Tutoring system

The screenshot shows a window titled "MathTutor" with a menu bar containing "File" and "Help". The main content area is divided into sections. The first section, "Your topic today is:", lists "Math", "Geometry", "Algebra" (which is highlighted in blue), and "Probability". Below this is a "Tutoring Panel" containing a blue text prompt: "Tutor >>>I really hope you are enjoying this exercise". This is followed by a question: "Question:If Sam can do a job in 4 days that Lisa can do in 6 days and Tom can do in 2 days, how long would the job take if Sam, Lisa, and Tom worked together to complete it?". The user's response is ">>> incorrect, correct answer was: 1.09 days". Below the response, there are five radio buttons for selecting a response: "1.95 days", "0.8 days", "1.23 days", "1.65 days" (which is selected), and "1.09 days". The final section, "Please choose the most relevent response to you:", contains nine buttons with various user feedback comments. At the bottom of the window, there is a standard Windows taskbar with navigation icons.

MathTutor

File Help

Your topic today is:

Math

Geometry

Algebra

Probability

Tutoring Panel

Tutor >>>I really hope you are enjoying this exercise

Question:If Sam can do a job in 4 days that Lisa can do in 6 days and Tom can do in 2 days, how long would the job take if Sam, Lisa, and Tom worked together to complete it?

>>> incorrect, correct answer was: 1.09 days

☐ 1.95 days ☐ 0.8 days ☐ 1.23 days ☒ 1.65 days ☐ 1.09 days

Please choose the most relevent response to you:

Whatever, I'm still so proud of myself

Thanks for giving me another chance

awwww come on that was tooooo hard. Give me something easier

Please, can we try something a little easier?

I don't agree with you on that

Stupid computer program!!

You are not an effective teaching tool!

But, there are more than one specific answer for this

But, that has nothing to do with this topic

Survey

37 participants (22 female)

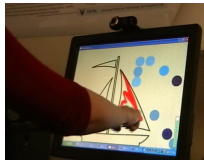
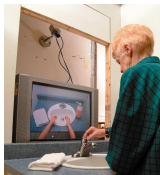
expression	behaviour	E	P	A
client expressions/client correct				
awwww come on that was toooo hard .	whine to	-1.23	1.27	0.31
bah - give me something harder	brag to	-0.42	1.69	1.35
You are an amazing tutor.	praise	2.96	2.5	1.5
client expressions/client incorrect				
Whatever, I'm still so proud of myself	defend	-1.58	0.09	0.13
Stupid computer program!!	yell at	-2.75	0.92	-0.21
You are not an effective teaching tool!	criticize	-2.65	1.35	-0.13
agent expressions/client correct				
Great going! Here's another one	encourage	3.38	2.62	1.93
Wow - amazing work. Here's an easy one	reward	2.9	1.63	1.6
I really hope you are enjoying this exercise	care for	1.37	0.63	-0.1
agent expressions/client incorrect				
I wonder if you are just too stupid for this	insult	-3.41	1.67	0.31
Come on, a little more concentration, OK?	admonish	-1.52	1.33	0.81
Sorry, I may have been too demanding on you	apologize	0.3	0.85	0.48
Can we do this a little quicker now?	hurry	-0.74	0.78	1.07

Trials

20 participants (7 female), T has $df=18$ and p is one-tailed. Scales ranged from 1 (=not true) to 5(=true). MT=Math Tutor mean deflection *BayesAct*: 2.9 ± 2.1 ; random: 4.5 ± 2.2 .

survey question	BACT	rand.	T	p
Communicating with MT was similar to communicating with a human.	2.10	1.70	0.87	n.s.
The tutor acted as if it understood my feelings while I was solving the problems.	2.80	2.00	1.92	< .05
I felt emotionally connected with MT.	2.50	2.00	1.00	n.s.
I enjoyed interacting with MT.	3.30	3.10	0.44	n.s.
MT acted as if it knew what kind of person I am.	2.90	2.11	1.55	< .10
MT gave awkward and inappropriate responses to how I solved problems (reverse coded)	3.44	4.50	-2.70	< .01
I found MT to be flexible to interact with.	3.00	1.90	2.18	< .05
Using MT would improve my skills in the long term.	3.40	2.00	2.49	< .05
The dialogue was simple and natural.	3.50	2.00	3.14	< .01
Overall, I am satisfied with this system.	2.70	1.70	2.34	< .05

Cognitive Assistive Technologies



Handwashing (fixed actions)

prompt: "command" ($EPA = [-0.09, 1.29, 1.59]$)

not prompt: "mind" ($EPA = [0.86, 0.17, -0.16]$).

turn	client state		action		agent expected		client	
	aw	ps	prop.	affect	f_c	ps	aw	defl.
initial	1	0	-	-	[0.9,-69,-1.05]	0	0.72	-
client	1	0	put on soap <i>"[looks at sink]"</i>	[1.6,0.77,-1.4]	[2.3,-0.77,-1.23]	0.96	0.94	0.23
agent	1	1	- <i>"[looks at client]"</i>	[0.85,0.17,-0.16]	[2.41,-0.81,-1.23]	1.0	≈ 1.0	1.34
client	1	1	turn on tap <i>"oh yes, this is good"</i>	[2.3,0.90,-1.19]	[2.62,-0.42,-1.43]	2.98	0.99	1.21
agent	1	3	- <i>"[looks at client]"</i>	[0.85,0.17,-0.16]	[2.7,-0.42,-1.5]	3.0	≈ 1.0	1.86
client	1	3	- <i>"oh yes, this is good"</i>	[2.2,0.79,-1.47]	[2.6,-0.30,-1.4]	3.0	≈ 0.0	1.56
agent	0	3	rinse hands <i>"Rinse your hands now!!"</i>	[-0.1,1.29,1.59]	[2.6,-0.30,-1.4]	3.0	≈ 0.0	4.11
client	0	3	- <i>"[looks at sink]"</i>	[1.9,1.4,-1.7]	[2.5,-0.30,-1.3]	3.0	≈ 0.0	2.90
agent	0	3	rinse hands <i>"Rinse your hands now!!"</i>	[-0.1,1.29,1.59]	[2.5,-0.29,-1.3]	3.0	≈ 0.0	5.80
client	0	3	- <i>"[looks at sink]"</i>	[1.9,0.97,-1.9]	[2.4,-0.27,-1.26]	3.0	0.02	4.28
agent	0	3	rinse hands	[-0.1,1.29,1.59]	[2.4,-0.26,-1.27]	3.0	0.02	7.05

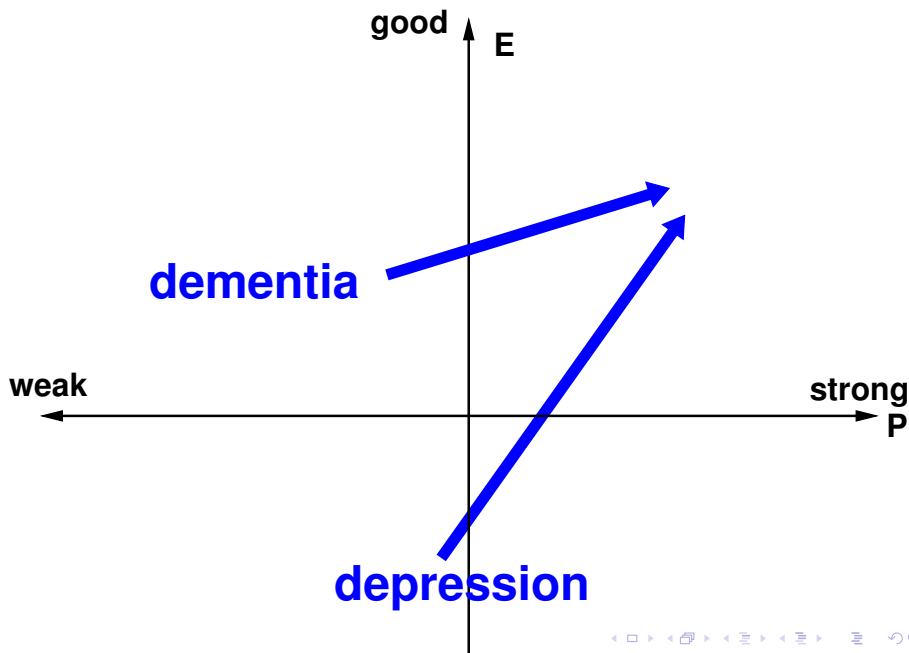
...continues for 48 more steps until client finally finishes ...

Handwashing (*BayesAct*)

all actions: *BayesAct*

turn	client state		action		agent expected			client defl.
	aw	ps	prop.	affect	f_c	ps	aw	
initial	1	0	-	-	[0.9,-0.69,-1.05]	0	0.72	-
client	1	0	put on soap <i>"[looks at sink]"</i>	[1.6,0.77,-1.4]	[2.3,-0.77,-1.23]	0.96	0.94	0.23
agent	1	1	- <i>"[looks at client]"</i>	[1.3,0.26,-0.40]	[2.41,-0.81,-1.23]	1.0	≈ 1.0	1.07
client	1	1	turn on tap <i>"oh yes, this is good"</i>	[2.2,0.90,-1.1]	[2.7,-0.36,-1.37]	3.0	0.99	0.99
agent	1	3	- <i>"I'm here to help, Frank"</i>	[1.3,0.4,0.35]	[2.7,-0.37,-1.38]	3.0	≈ 1.0	1.47
client	1	3	- <i>"this is nice"</i>	[2.1,0.72,-1.4]	[2.6,-0.34,-1.38]	3.0	0.01	1.14
agent	0	3	rinse hands <i>"Great job, Frank, time to rinse your hands now"</i>	[1.5,0.67,0.06]	[2.6,-0.34,-1.39]	3.0	≈ 0.0	1.50
client	0	3	rinse hands <i>"oh yes, this is good"</i>	[1.9,0.78,-1.4]	[2.7,-0.31,-1.44]	4.0	0.99	1.11
agent	1	4	- <i>"good job Frank"</i>	[1.6,0.47,-0.13]	[2.7,-0.30,-1.4]	4.0	≈ 1.0	1.61
client	1	4	turn tap off <i>"[looks at tap]"</i>	[2.0,0.94,-1.3]	[2.6,-0.17,-1.24]	5.9	0.96	1.19
agent	1	6	- <i>"This is nice, Frank"</i>	[1.5,0.56,-0.35]	[2.6,-0.17,-1.2]	6.0	≈ 1.0	1.56
client	1	6	- <i>"Oh yes, good good"</i>	[2.1,0.86,-1.42]	[2.8,-0.14,-1.14]	6.0	≈ 0.0	1.22
agent	1	6	dry hands <i>"[looks at]"</i>	[1.4,0.66,-0.06]	[2.8,-0.13,-1.36]	6.0	≈ 0.0	1.55
client	1	6	dry hands <i>"all done!"</i>	[1.94,1.1,-1.9]	-	-	-	1.55
client	1	7	-	-	-	-	-	-

Affect Control Theory



Is ACT relevant to H.C.I. or A.I.?

Shank (2010) showed that people

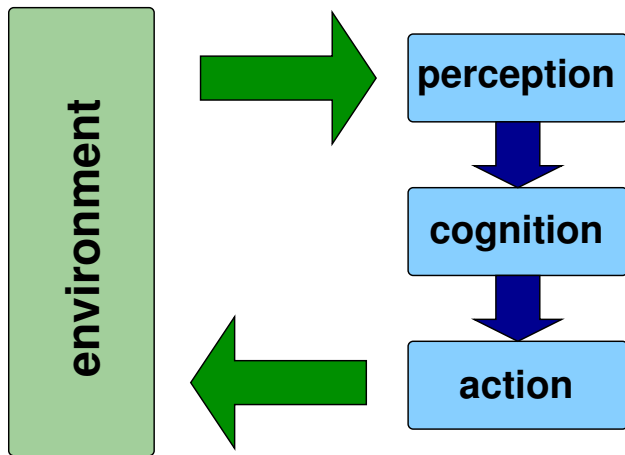
- ▶ have shared cultural identity labels for technological actors,
- ▶ share affective sentiments about these labels.
- ▶ view these technological actors as behaving socially,

Reeves and Nass (1996) *The Media Equation* showed:

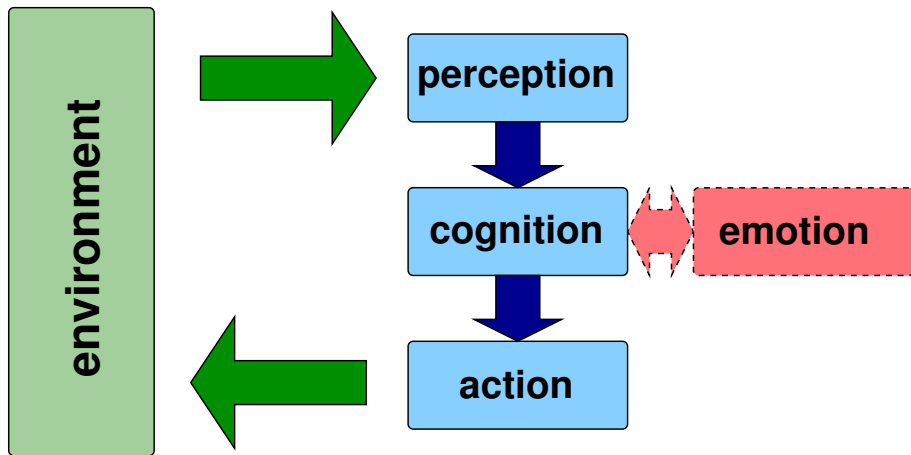
- ▶ people treat media as real life
- ▶ it is hard for people to **not** do this

Affect control theory gives an explanation for this!

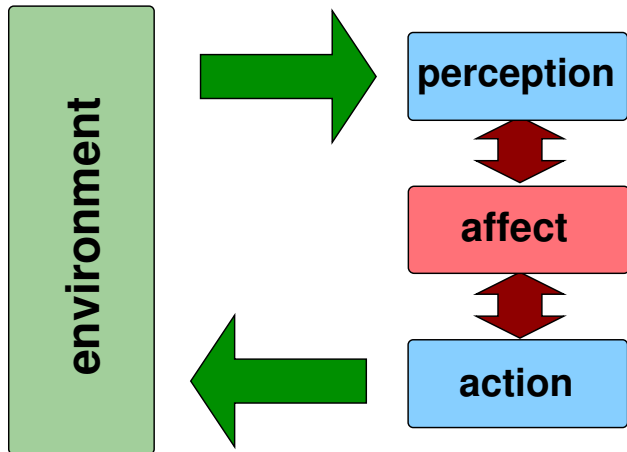
Traditional AI:



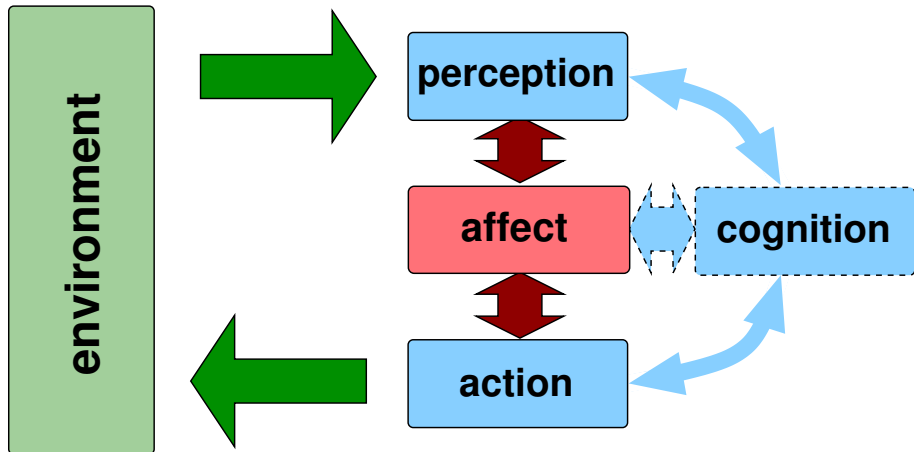
Traditional AI:



Affect Control Theory:



Affect Control Theory:



Future work

- ▶ Sentiment analysis (input/output mappings)
- ▶ Efficiency
- ▶ Neural network models
- ▶ Learning parameters (including non-linear features) of POMDP
- ▶ Policy computation and manipulative agents
- ▶ Applications
 - ▶ Tutoring system
 - ▶ Assistive Technologies
 - ▶ Therapeutic agents
 - ▶ Advertising agents
 - ▶ Social Networks
 - ▶ Machine Translation
- ▶ Negotiation of new meanings - learning X .