

Adapting to Agents' Personalities in Negotiation

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Focus of Work

Building helpful behavior between agents that

- must negotiate over resources to succeed
- are uncertain about others' resources and utilities
- may not fulfill commitments

Contributions

- decision-making model that reasons about and adapts to others' helpfulness
- empirical investigation using a new test-bed

Evaluation Methodology

Colored Trails [Grosz and Kraus '04]

- Formalism for investigating decision-making
- Easy to configure complex negotiation settings
 - large space of strategies
 - varying dependency relationship

The screenshot displays the 'Colored Trails' game interface. It includes a 'Propose Exchange' dialog box, a game board, and a 'Chips' table.

Propose Exchange Dialog:

- Recipient: [Sun icon]
- Chips to Offer: [0] [0] [1] [0] [0]
- Chips to Request: [1] [0] [0] [0] [0]
- Exchange Order: Simultaneously
- Buttons: Cancel, OK

Board: A 5x5 grid with colored cells (red, orange, green, blue) and player pieces (Sun, me, radiation, @).

Chips Table:

Player	Idle
[Sun icon]	2	0	0	4	5	3
me	2	2	5	0	3	2
[radiation icon]	2	0	4	4	0	4
[@ icon]	2	2	4	2	4	0

Related Work

Social decision-making models

- explicitly reason about others' utilities [Hogg and Jennings '01, Zhang *et al.* '02, Rabin '03]
- represent agents' helpfulness but do not adapt to others' strategies [Castelfranchi *et al.* '98]

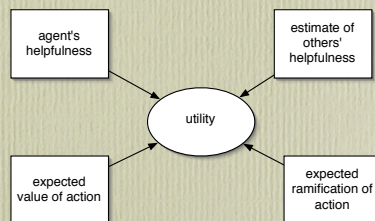
Our Approach

Agent's utility is a weighted average of

- Helpfulness measure of all agents in system
 - cooperation (fraction of times chips were offered)
 - reliability (fraction of times commitments were fulfilled)
- Expected score for an action
 - likelihood of reaching goal (function of missing chips)
- Expected ramification of an action (constant)

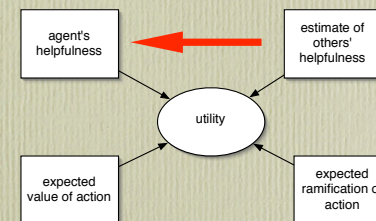
Agent Types

1. Constant Level of helpfulness (Single Personality)



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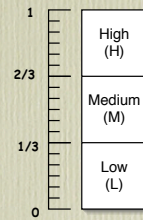


2. Varying Level of helpfulness (Multi Personality)

Matching Personality to Behavior

- Multiple Personality (MP) agent matched its own personality to its estimate of others' based on a series of 2-player games

Example - the MP agent will adopt a low cooperation measure to medium reliability type agents



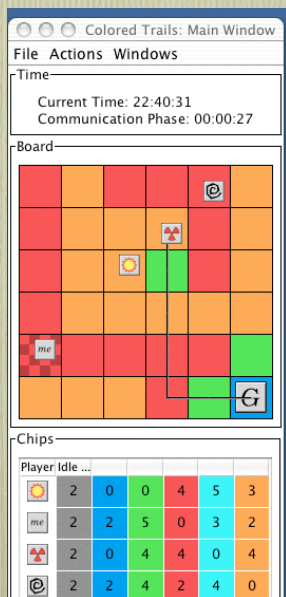
Making Decisions

Multi and Single Personality agents perform the subset of actions which

- maximize aggregate utility
- do not conflict with each other

They update their estimate of others' helpfulness at each step of the game.

This provides for reciprocative decision-making



Upon receiving an offer in return for chips it lacks

- unhelpful Single Personality agent accepted the infeasible offer
- Multi Personality agent proposed a counter offer for chips it possesses

Empirical Methodology

Ran 5,040 series of 2- and 4-player CT games

- full board visibility, limited chip visibility

Games varied parameters

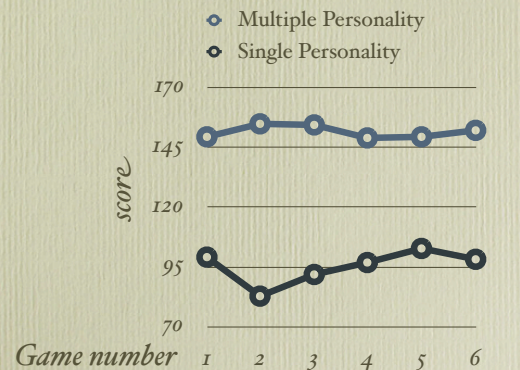
- board size and initial chip distribution
- task dependence/independence
- agent configuration (MP, ???)

Hypothesis was that Multiple Personality agent will

- outperform all other players
- realize more beneficial exchanges
- increase the social welfare of the system

Results (6 repeated games)

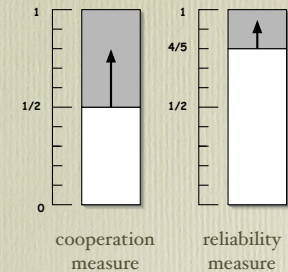
Average Performance by Game



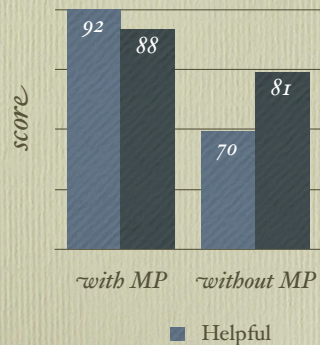
Evaluating Performance

- Agents are distributed into helpful/unhelpful groups.
- Recorded each group's scores, exchange types (reciprocal, idle) and compared with that of Multi Personality agent.

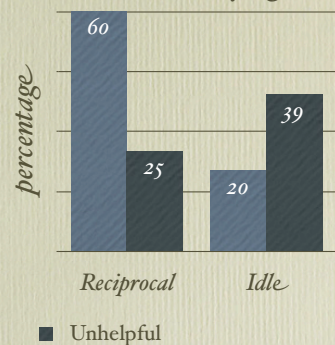
Helpful behavior classification



Effect of Multi Personality agent on social welfare



Exchange Types Proposed by Multiple Personality agent



Future work

- integrate learning (for matching table or expected ramification computation)
- investigate how several Multi Personality agents interact together

Conclusion

- agents which adopt a separate strategy for each type of opponent are more successful
- configurable test-beds are a useful tool for investigating decision making in MAS

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